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Beckwith (C. S.). **The Insects of the cultivated Blueberry.**—*Circ. N. J. Dep. Agric.* no. 356 pp. 43–50. Trenton, N.J., 1945.

Most of the information in this paper on the more important of the insects that attack cultivated blueberry in New Jersey has already been noticed [*R.A.E.*, A **32** 282 ; **33** 401]. Additional control measures suggested include the use of lead arsenate (6 lb. per 100 U.S. gals.) in a delayed dormant spray of lime-sulphur (1 : 9) in April, when the adults appear, or in Bordeaux mixture (8 : 8 : 100) later in the year against *Anthonomus musculus*, Say, and of ½ oz. granular calcium cyanide, sprinkled for a distance of one foot round each plant and raked in lightly, against adults of *Rhabdopterus picipes*, Ol.

Less important pests include *Hyphantria cunea*, Dru., *Datana angusi*, G. & R., *Tortrix* (*Archips*) *rosaceana*, Harr., *T.* (*A.*) *georgiana*, Wlk., *T.* (*A.*) *argyrospila*, Wlk., and *Gracilaria* sp., which feed on the leaves. *Aroga* (*Gelechia*) *trialbamaculella*, Cham., which is generally distributed on blueberries and also attacks cranberries, is of potential importance but has so far been controlled by parasites. The larvae overwinter in cocoons in the dried leaves on bushes or in soil, and the adults appear in early spring and oviposit on the new growth. The larvae of the first generation make tunnels 3–4 inches long in the tips of the young stems but later feed on the leaves within webs. There are two and possibly three generations in the year, but stem-boring has been observed only in the first.

Mitchell (B. L.). **Exploratory Trials of Gammexane and other Chemicals in the Control of Tobacco Soil Pests.**—*Rhod. agric. J.* **43** no. 2 pp. 126–130 ; also as *Bull. Minist. Agric.* [*S. Rhod.*] no. 1345, 6 pp. Salisbury, S. Rhod., 1946. **A Correction.**—*Rhod. agric. J.* **43** no. 5 p. 389.

Experiments were carried out in Southern Rhodesia in the summer of 1945–46 to test the efficiency of a dust of china clay and benzene hexachloride, at a concentration to give 0·5 per cent. γ isomer, when applied at rates of 25–200 lb. per acre to the soil of tobacco fields for the control of white grubs of the genera *Anomala*, *Schizonycha* and *Adoretus* and false wireworms (*Psammodes similis*, Pér.). The dust was mixed with chemical fertiliser and applied when the hills were being prepared for planting on 21st December. Flowers of sulphur, broadcast and hoed in at 600 lb. per acre on 27th October, at the beginning of egg-laying, and followed by an application of fertiliser on 21st December, and flake naphthalene, applied at 170 lb. per acre with fertiliser on 21st December, were also tested. Each treatment was replicated five times in randomised plots, with two series of untreated plots. The tobacco was planted on 28th December, and counts of the larvae were made on 8th–11th January and 4th–8th February. The numbers of white grubs present per 50 sq. yards in January and (in brackets) per 65 sq. yards in February were 166 (190) and 281 (243) for no treatment, 79 (55), 98 (64), 97 (50), 50 (24) and 138 (49), respectively, for the benzene-hexachloride dust at 25, 50, 100, 150 and 200 lb. per acre, 64 (101) for sulphur, and 124 (176) for naphthalene, the differences required for significance being 92 (70). These erratic results were found to be due to the very uneven distribution of the grub population in the test area, but statistical analysis of the degree to which the numbers of grubs exposed to the individual treatments had changed between January and February indicated that mortality increased with increasing dosages of benzene hexachloride, though the differences from both controls were not significant except at the highest rate and there was no significant difference between treatments, and that the sulphur and naphthalene appeared to have given the white grubs some protection from natural enemies.

The numbers of larvae of *P. similis* present in January were 44 and 39 for no treatment, 23, 15, 16, 11 and 11 for 25, 50, 100, 150 and 200 lb. benzene-hexachloride dust per acre, 29 for sulphur and 30 for naphthalene (significant

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difference 15·37). In February, there was a slight increase in population in all plots owing to normal reproduction. The larvae were much more evenly distributed over the test area than the white grubs.

It is considered that the lack of significant differences in the control of either white grubs or *Psammodes* given by the benzene-hexachloride dust at rates of 25 and 200 lb. per acre was mainly due to the fact that it was applied in a concentrated layer at the base of each hill, thus occupying only about a quarter of the area of the field, and that much better results could be obtained by broadcasting it over the entire surface of the soil, so that it would come in contact with more of the larvae.

WALLACE (C. R.). **Small-scale Tests with D.D.T. and Benzene Hexachloride incorporated in the Soil.**—*J. Aust. Inst. agric. Sci.* **13** no. 3 pp. 132–137, 1 ref. Sydney, 1947.

The experiments described were carried out in New South Wales in 1945 as a preliminary to field experiments already noticed on the value of DDT and benzene hexachloride for the protection of maize against *Heteronychus sanctae-helenae*, Blanch. [*R.A.E.*, A **35** 218]. The dusts used contained 10 per cent. DDT (9·5–10 per cent. p,p′ isomer) and 14 per cent. benzene hexachloride (1·07 per cent. γ isomer), both on pyrophyllite and both diluted to the desired concentrations with kaolin, as well as a mixture of equal quantities of kaolin and pyrophyllite as a control dust. In all tests, the dusts were mixed with soil at the rate of ½ lb. per gal. ; thus a 6 or 2 per cent. dust gave 3 or 1 oz. insecticide per cu. ft. soil.

Maize seeds sown in the open on 21st–24th September germinated normally in soil treated with 6 per cent. DDT or with the control dust, but did not germinate in soil treated with 6 per cent. benzene hexachloride, except for two out of 44 seeds, which produced deformed plants. The soil that had been treated with the DDT and the control dust, together with the plants growing in it, was placed in large pots on 16th October, and 20 adults of *Heteronychus* were placed in each pot under a cage three days later. By late November, when the test ended, 45 per cent. of the plants in the control pots were dead and 18 per cent. injured beyond recovery, whereas no characteristic symptoms of attack were observed in the DDT series. Such observations as could be made without disturbing the soil showed that the DDT killed a substantial proportion of the beetles. In a similar test in which maize seeds were sown in pots of treated soil, dusts containing 0·5 and 2 per cent. benzene hexachloride did not reduce germination and protected the young plants from attack by the beetles, but caused severe stunting and malformation, whereas a 6 per cent. DDT dust protected the plants without injuring them. At the end of this experiment, which lasted a month, eggs and young larvae were found in the soil of the control pots, but not in the soil treated with the insecticides. In a final test, in which the plants were not exposed to beetles, the seeds germinated well in soil treated with dusts containing 0·27 and 0·11 per cent. benzene hexachloride, but the lower concentration dwarfed the developing plants, and the higher concentration caused both stunting and slight malformation of the roots and leaves.

MILLER (L. W.). **Populations of *Thrips tabaci* Lind. on Bean Varieties.**—*J. Aust. Inst. agric. Sci.* **13** no. 3 pp. 141–142, 5 refs. Sydney, 1947.

In February 1947, severe damage by *Thrips tabaci*, Lind., which was prevalent on flowers and vegetables in southern Tasmania during the summer of 1946–47, was observed on beans in a small-scale varietal test. Counts of the nymphs present on leaves from the top, middle and bottom of plants of the 15 varieties involved showed that the thrips were not confined to any particular zone of the

plant and that the mean numbers per leaf were 2 and 61·6 on the varieties New Discovery and Hawkesbury Wonder, respectively, and 5·1–17·5 on the other 13 varieties. Statistical analysis showed that the population on New Discovery was significantly less than that on any other variety and the population on Hawkesbury Wonder greater than that on all other varieties. Hawkesbury Wonder in another varietal trial about 20 miles distant was also much more heavily infested than the other varieties in the plot. It has very hairy leaves, and it is thought that the hairs produce a micro-climate that favours breeding and protect the nymphs from attack by the larger natural enemies [*cf. R.A.E.*, A **23** 94].

The Use of DDT and 666 as Insecticides against Grain Pests. Part I. Incorporation of DDT and 666 in Wall Washes.—*J. sci. industr. Res.* **4** no. 2 pp. 73–77, 8 graphs, 1 ref. Delhi, 1945. **Part II. Effect of Lime on DDT when incorporated in Lime Wash.**—*T.c.* pp. 78–79, 1 ref. **Part III. The Persistence of Toxicity of DDT and 666 applied in Wall Washes.**—*T.c.* no. 8 pp. 493–495, 3 graphs, 2 refs. 1946. **Part IV. DDT and 666 as Sterilisants of Floor Debris in Grain Storage Sheds.**—*T.c.* pp. 495–499, 9 graphs, 2 refs.

The experiments described in this paper were carried out at Cawnpore, and those recorded in the first part were designed to compare the initial insecticidal efficiency of DDT and of benzene hexachloride (666) when incorporated in lime and chalk wall washes in different proportions. In the first series, DDT (85 per cent. p,p′ isomer) was mixed with a wash of 300 gm. slaked lime and 1,200 cc. water by grinding it in a mortar with gradually increasing quantities of the wash. In the second, emulsion concentrates were prepared by mixing a solution of 2 gm. soft soap and 2 gm. resin with one of 16 gm. ground-nut oil, 10 gm. DDT or 4 gm. benzene hexachloride (10–12 per cent. γ isomer), 24 gm. toluene and 0·2 cc. distilled water and added to washes made from freshly prepared quick-lime or precipitated chalk and twice their weight of water. The washes were applied to experimental chambers of cement concrete with internal dimensions of $5\frac{1}{2} \times 5\frac{1}{2} \times 4$ ins. Several coats were applied with a brush until 200 cc. of the first wash and about 10 gm. chalk or lime in the others had been used, and after the deposits had dried for 24 hours, adults of *Tribolium castaneum*, Hbst., *Rhizopertha dominica*, F., and *Calandra* sp. were introduced, with 5 gm. crushed wheat for food. Deposits of 570, 284, 142 and 71 mg. DDT per sq. ft. and 400 mg. calcium hydroxide per sq. in. were obtained with the first wash, and those obtained with the emulsions were 69·7, 35·4 and 17·6 mg. DDT and 70·4, 34·9 and 18 mg. benzene hexachloride per sq. ft. with 88 mg. chalk per sq. in., and 70·6, 35·5 and 17·7 mg. DDT and 70·3, 35·3 and 17·5 mg. benzene hexachloride per sq. ft. with 64·7 mg. calcium hydroxide per sq. in. In the chalk-wash emulsion, DDT gave complete mortality of all three insects in eight days at the lowest concentration, and benzene hexachloride was as effective as DDT against *Calandra* and *Rhizopertha* but rather less so against *Tribolium*. In the lime-wash emulsion, DDT was less effective, the only insect of which complete mortality was given by the lowest concentration in 18 days being *R. dominica*, and benzene hexachloride was much less so, giving incomplete mortality of all insects at all concentrations. DDT ground with lime gave much slower kills and at the lowest concentration did not produce complete mortality of any insect in 54 days. This result was unexpected, since DDT in suspension would be less likely to be decomposed by lime than DDT in solution and it is therefore suggested that the DDT that separates out from an oil in an oil-in-water emulsion tends to concentrate on the surface of the dried film, whereas in a solid suspension it is evenly distributed throughout the film ; a difference in the physical state of the DDT deposited from an emulsion and from a solid suspension may also have been responsible.

In the second part, an account is given of experiments carried out to investigate the nature of the reaction between lime and DDT, which it was thought might take place during the mixing of the wash or during drying and carbonation after its application. Pure p,p′ DDT was made up in various ways, usually in the proportion of 1 part DDT to 50 parts lime, and analyses for DDT carried out. The results showed that no DDT was lost when solid DDT was mixed with calcium hydroxide dry or in the presence of water, when the second mixture was allowed to dry on glazed tiles or when an emulsified solution of DDT was mixed with calcium-hydroxide paste, whereas an alcoholic solution of DDT mixed with calcium-hydroxide paste, which precipitated finely divided DDT on to the lime, and the emulsified solution mixed with calcium-hydroxide paste and allowed to dry on glazed tiles, which gave a deposit in which finely divided DDT was thoroughly mixed in the lime, lost 85 and 65 per cent. in 24 hours, respectively. It thus appears that the rate of degradation of DDT in lime washes depends on the state of division and intimacy of contact of the DDT and lime particles. Isolation of the degradation product of the mixture of DDT in alcohol and calcium-hydroxide paste showed it to be bis(parachlorphenyl)dichlorethylene.

The third part contains the results of tests to determine the duration of effectiveness of the treatments recorded in the first part and to confirm the fact that DDT is destroyed by lime. Emulsified solutions of DDT in lime wash caused no mortality of adults of *Tribolium castaneum* enclosed in the experimental chambers one month after the treatments had been applied, whereas the two highest concentrations of DDT ground with lime wash still gave over 30 per cent. mortality in 18 days when the insects were introduced four months after treatment, as compared with complete mortality in 17 days for a fresh application at the highest concentration. The rapidity of the effect of lime on DDT in emulsified solution was shown in a test in which chambers treated with an emulsion in lime wash were allowed to stand for 2–3 days before the insects were admitted. In these, the highest concentration gave only 48 per cent. kill in 17 days, as compared with 100 per cent. in eight days recorded in the first part when insects were admitted the day after treatment, and the lowest concentration gave only 13 per cent. as compared with 32 per cent. Comparison of the insecticidal effect of deposits from emulsified solutions of DDT and benzene hexachloride in chalk wash two months after application with that of fresh deposits showed that both persisted well, the time taken for deposits of 35 mg. per sq. ft. to produce 70 per cent. mortality being increased from 4½ to 7 days and from 4 to 10 days, respectively, and complete kill being obtained in 12–18 days. Deposits of 17·5 mg. per sq. ft. gave complete mortality in 29 and 24 days, respectively.

In the fourth part, details are given of experiments to estimate the efficiency of DDT and benzene hexachloride for the treatment of floor débris such as accumulates in grain stores in India, whence it cannot always be easily removed. DDT (80 per cent. p,p′ isomer) and benzene hexachloride (10–12 per cent. γ isomer) were diluted with kaolin and mixed with whole wheat flour to give concentrations of 157, 105 and 53 parts insecticide per million and a 16 per cent. dust of benzene hexachloride in gypsum and the same dust diluted with china clay (1 : 3) were used in the same way to give concentrations of 84 p.p.m., and 50 adults of *T. castaneum* were caged with each mixture and examined daily for 26 days in April. Fresh insects were enclosed with the same samples of flour for 29 days during June, and, finally, a similar test was carried out for 24 days in July on the mixtures containing the highest concentrations. In the first month, DDT and benzene hexachloride at the highest concentration both gave approximately 50 per cent. kill in three days, and the former complete kill in 19 days. No other treatment gave complete mortality during the test, and benzene hexachloride was less effective than DDT. Little mortality

occurred after the first 14 days, and the same was observed during the second month of test, when the highest concentration of DDT and benzene hexachloride gave 50 per cent. mortality in 11 and 5–8 days, respectively, and none of the treatments gave complete kill. During the third month, the mortality was more evenly distributed and was 44 per cent. for the DDT and 34 per cent. for the benzene hexachloride. The low mortality towards the end of the first two test periods may be due to the development of tolerance in insects that survive for a time or to variations in the resistance of the insects. Kaolin mixed with the flour had no effect on insect mortality.

MELIS (A.). **Sulla convenienza economica di eseguire sempre la lotta contro la tignola dell'olivo** (*Prays oleellus* **F.**). [On the economic Advisability of continuing a perpetual Campaign against *P. oleellus*.]—*Redia* **31** pp. 3–52, 4 refs. Florence, 1946.

Growers have for some years used arsenicals against *Prays oleellus*, F., on olive in Tuscany, but claim that little benefit results. Experiments were therefore carried out in 1943 in two districts near Florence to assess the value of the treatment. Sprays containing 5 lb. lead, aluminium, calcium or zinc arsenate per 100 gals. water or Bordeaux mixture, with an adhesive, and dusts containing lead or aluminium arsenate in an inert carrier were applied against the overwintered larvae on the leaves, the first-generation larvae in the flowers, or both. Infestation in 1943 was light, and it was a good crop year. In one district, treatment against the overwintered larvae killed up to about 20 per cent. of them, with little difference between sprays and dusts, but there was little reduction in infestation of the flowers as a result, and treatment against the first generation had very little visible result. The difference in yield between untreated trees and those that received both treatments was negligible. Similar results were obtained in the second district.

No treatments could be carried out in 1944 or 1945, but observations on the extent of infestation were continued. In 1944, the overwintered generation was largely controlled by weather, and some 7–8 per cent. of the flower-buds were attacked, ranging up to 32 per cent. in sheltered situations. In 1945, when the crop was poor, a greater percentage of the foliage was attacked, but fewer of the flower-buds.

The author concludes that infestation was comparatively light in all three years, and that the damage to leaves and flowers was negligible ; since only 5–9 flowers out of an average of 15 in a flower-cluster normally set fruit and the immature fruits must be further thinned if the load is not to exhaust the tree, an infestation of even 30 per cent. of the flowers is not important. Treatment against the early generations is thus not justified, but the use of an ovicide spray against the eggs laid on the young fruits by the first-generation adults might be of value to prevent the loss of fruits caused by second-generation larvae.

MELIS (A.). **Elenco della principali specie di insetti che hanno prodotto infestazioni degne di nota in Italia durante gli anni 1945–1946.** [A List of the principal Species of Insects that caused Infestation worthy of Notice in Italy in the years 1945–46.]—*Redia* **31** pp. xxv–xxxi. Florence, 1946.

This is the first of a proposed series of lists of insect pests of plants in Italy that are to be published each year, and itself deals with the years 1945 and 1946. The insects are arranged systematically, and notes are given in most cases on the plants attacked, the severity of the infestation and the locality in which it was observed.

FREIBERG (M. A.). **Investigaciones sobre el género *Dysdercus* Serville (Hemipt. Pyrroc.).** [Investigations on the Genus *Dysdercus*.]—*Bol. Direcc. Algodón* no. 125–126 pp. 362–380, 18 figs., 6 graphs, 14 refs. Buenos Aires, 1945.

The text of the first part of this paper, which deals with the bionomics and morphology of all stages of *Dysdercus pallidus*, Blöte, is almost identical with that in a previous paper in which it was recorded as *Dysdercus* sp. [*R.A.E.*, A **32** 106]. *D. pallidus* is now stated to be the most widely distributed species of its genus in Argentina.

The second part comprises an account of the bionomics and descriptions of all stages of an unidentified species of *Dysdercus* that was observed in 1943 on cotton in the Territory of Formosa and also in Paraguay; it occurred in association with *D. pallidus* but was far less numerous. As with the latter species, differences in temperature produced changes in colour and variations in the duration of the life-cycle. In the laboratory, the egg stage and total development were completed in 5 and 24–42 days, respectively, at a mean temperature of 30·5°C. [86·9°F.] and in 14 and 60–100 days at mean temperatures ranging from 17·6 to 26·6°C. [about 64–80°F.]; the nymphs did not develop at mean temperatures of 15°C. [59°F.] and below. Oviposition began 7–14 days after the adults emerged; the eggs were laid among débris in batches of 43–112, at intervals of 2–6 days or sometimes longer. Up to eight such batches were laid by individual females. The maximum total number of eggs deposited by a single female was 675.

DOUCETTE (C. F.) & LATTA (R.). **The Lily Weevil, a potentially serious Pest in the Pacific Northwest.**—*Circ. U.S. Dep. Agric.* no. 746, 24 pp., 18 figs., 5 refs. Washington, D.C., 1946.

In the summer of 1935, serious damage to bulbs of Easter lily (*Lilium longiflorum*) by larvae of *Agasphaerops nigra*, Horn (*Panscopus sulcirostris*, Pierce) [*cf. R.A.E.*, A **5** 223; **8** 438] was reported by several growers in Oregon; about 10 per cent. of the plants were attacked in one planting in the south-west. This weevil, all stages of which are described, occurs throughout the Pacific coastal region from Vancouver Island to northern California, and in view of its potential economic importance, investigations, the results of which are given, were carried out on its bionomics and control.

At least three genera and six species of wild and cultivated liliaceous plants have been found to be attacked by the larvae and adults, but caged adults consistently refused to feed on the foliage of species of 15 other genera or on that of *Narcissus* sp., *Vallota purpurea* or *Iris* sp. The adults feed on the edges of the leaves of lilies, and the larvae on or in the underground parts of the stems or in the bulbs. The life-cycle occupies two years. In southern Oregon, most of the eggs are laid in May; they are inserted under the epidermis of the lower leaves. The larvae, which hatched in 15–28 days at room temperature, sometimes feed in the leaves for a time but eventually move to the stem of the plant, which they either enter or follow downwards to the bulb. Some feed on the surface of the stem, while others tunnel within it, feeding on the pith and later on the bulbs; stem bulblets are also injured. The larvae leave the bulbs or stems in early autumn and overwinter in cells in the soil at a depth of 10–18 ins. The pupal stage is completed in the following summer, but the adults overwinter in the cells and do not come to the surface until late March or early April. When not feeding, they shelter in surface litter near the plants. Few adults were observed in the field after mid-June, and most died about mid-July in the laboratory. Since they are unable to fly, the spread of the species over any distance is probably due to transport of infested plants.

As the adults feed voraciously for about a month between emergence from the soil and oviposition, a spray of 2 lb. lead arsenate in 50 U.S. gals. water,

with 1 U.S. pint sulphonated petroleum oil as spreader and adhesive, was tested for their control on moderately infested plantings of Easter lilies. In 1936, when it was applied four times between 23rd April and 19th May, 30 per cent. fewer eggs were laid on sprayed than on unsprayed plants and the average numbers of larvae per plant were 1 on the former, and 4·5 on the latter. Very few bulbs were damaged in the sprayed plantings in that year or in 1937, when three applications of the spray were made in approximately the same period, and it was further observed that 39 per cent. of the adults taken from foliage first sprayed two days before were dead within a week, as compared with 3 per cent. of those from unsprayed foliage. The authors recommend that a spray of lead arsenate and a spreader should be applied five times at ten-day intervals, beginning as soon as the feeding notches of the adults are evident on the foliage. There should be an interval of at least three years between lily crops on the same ground.

Whitten (R. R.) & Parker (D. E.). **Experimental Control of Shade-tree Insects with DDT.**—*Proc. 21st nat. Shade Tree Conf. 1945* pp. 13–17. Wooster, Ohio [1946].

In this paper, the results are summarised of preliminary experiments carried out by members of the Division of Forest Insect Investigations of the U.S. Bureau of Entomology and Plant Quarantine on the use of DDT to control insects attacking shade trees. Sprays were chiefly used, and typical formulae are given for incorporating DDT in a solution, an emulsified solution and a wettable powder in which it is ground with pyrophyllite and the mixture suspended in water with the aid of a wetting agent. Solutions and emulsified solutions were usually more effective than suspensions, and the more volatile solvents for DDT produced a more durable residual effect. In emulsified solutions against defoliating insects, 0·1–1 per cent. DDT controlled *Hyphantria cunea*, Dru., *Ceratomia catalpae*, Boisd. (on *Catalpa*), *Thyridopteryx ephemeraeformis*, Haw., and *Homadaula albizziae*, Clarke (on *Albizzia*) and prevented oviposition by *Monarthropalpus buxi*, Lab. (on box), 0·5 per cent. controlled larvae of *Galerucella luteola*, Müll. (*xanthomelaena*, Schr.) (on elm) and *Melasoma* (*Chrysomela*) *lapponica* var. *interrupta*, F. (on willow), eggs and small larvae of *Chalepus dorsalis*, Thnb. (on locust trees [*Robinia*]) and adults of *Crepidodera* (*Chalcoides*) sp. (on willow), 0·1 per cent. was effective against *Malacosoma americana*, F., when applied to the egg bands, tents or foliage, and 0·12 per cent. gave complete control of *Lymantria* (*Porthetria*) *dispar*, L., when applied before the eggs hatched. A 12 per cent. DDT solution, applied by aeroplane, controlled *Anisota rubicunda*, F., *A. virginiensis*, Dru., and *Heterocampa* spp. at 5 lb. DDT per acre, and *Neodiprion lecontei*, Fitch, and *Gilpinia* (*Diprion*) *frutetorum*, F. (on pines) at 2½–3 lb. DDT per acre. Both suspensions and emulsified solutions containing ½ lb. or more DDT per 100 U.S. gals. were effective against *Harmologa* (*Archips*) *fumiferana*, Clem. Females of *Alsophila pometaria*, Harr., were killed in the field when the tree trunks were dusted to a height of four feet with a mixture of DDT and pyrophyllite (1 : 1) and died within 48 hours in laboratory cages sprayed with an emulsion containing 5 per cent. DDT; the larvae were effectively controlled with a 1 per cent. emulsion.

In emulsified solutions against Hemiptera, 0·5 per cent. DDT gave at least 95 per cent. control of *Gossyparia spuria*, Mod., and *Myzocallis ulmifolii*, Monell, both on elm, and 0·1–1 per cent. DDT gave complete mortality of *Aphrophora saratogensis*, Fitch, with a distinct repellent effect, and readily killed one or more species of Jassids, Fulgorids, Membracids and Cercopids, all in the laboratory.

Among the bark-beetles and borers, adults of *Megacyllene* (*Cyllene*) *robiniae*, Forst. (on *Robinia*) were readily killed by 2 per cent. DDT in emulsified solution, which was effective when applied to the stems of the trees before oviposition, and those of *Pissodes strobi*, Peck (on pine) by 1 per cent. ; and emulsions and solutions containing 1–2 per cent. DDT prevented feeding on elm by adults of *Scolytus multistriatus*, Marsh., and also prevented it from breeding in elm wood.

Preliminary tests on sprayed elms indicated that the foliage injury observed was caused by the solvent and depended on its volatility, an emulsified solution of DDT in xylene being less injurious than one in which heavier, less volatile oils were used.

WALLIS (R. L.). **Seasonal Occurrence of the Potato Psyllid in the North Platte Valley.**—*J. econ. Ent.* **39** no. 6 pp. 689–694, 2 figs., 6 refs. Menasha, Wis., 1946.

The results are given of investigations on populations of *Paratrioza cockerelli*, Šulc, on cultivated and non-economic food-plants, carried out in the North Platte Valley of Wyoming and Nebraska in 1940–44. Samples were taken at 5–7 day intervals by sweeping with a net at observation points established at random throughout the valley in plantings of tomatos, which are generally grown from plants set out between 15th May and 15th June, and of early, early late and late potatoes. The early potatoes are planted in April, reach maximum growth in July and are harvested in August ; the others are planted between 25th May and 5th June and between 20th and 30th June, respectively, reach maximum growth in September and are harvested in September-October. In 1941, the Psyllid was found to be numerous early in the season on *Lycium halimifolium* and on potatoes growing in piles of discarded tubers, and these plants were included in the survey. Leaves of *Lycium* begin to appear about the beginning of April and remain until frost in autumn ; growth of the potatoes begins in early April and is rapid during May and June, but the plants die for lack of water in July or early August.

Since there was no apparent relation between the sizes of the populations in successive seasons or between winter temperatures or rainfall and populations in the following summer, it appeared that the Psyllid does not overwinter in the valley. Most of the adults migrating from overwintering sources settled on *Lycium* and potatoes growing in waste piles and produced large spring populations. When these potatoes died, the Psyllids migrated to cultivated plants, mainly early potatoes, in July, as these were large enough to afford them shelter. A migration from early potatoes to other crops occurred when the former were harvested in August. *Lycium* was a far less important source of infestation than potatoes in waste piles as it retained its leaves until autumn and many of the Psyllids remained on it. Populations were slightly larger on tomatos than on early late and late potatoes.

Low temperatures in May tended to retard the movement of Psyllids into the valley, and the greatest increases occurred during June when temperatures were between 60 and 70°F. High temperatures in July retarded population increase except on early potatoes, which were large enough to protect the insects from the sun, but high temperatures in August, when all the plants were growing rapidly, had little effect. Populations reached a peak at about the middle of September unless early killing frosts occurred and then decreased owing to the lower temperatures, which apparently induced a movement to hibernation quarters. *Solanum rostratum* and species of *Physalis*, which are common wild food-plants of the Psyllid, are relatively unimportant in this region because their leaves do not appear until May and June and remain until autumn.

DeBach (P.). **An insecticidal Check Method for Measuring the Efficacy of entomophagous Insects.**—*J. econ. Ent.* **39** no. 6 pp. 695–697, 4 refs. Menasha, Wis., 1946.

The author describes two tests in California of a method for measuring the effectiveness of entomophagous insects by which the populations of host insects on a plot having the natural enemies normally present or purposely introduced and on one treated with an insecticide that will eliminate or greatly reduce the enemies without much affecting the hosts are compared.

In one test, *Citrus* trees bearing similar populations of *Pseudococcus adonidum*, L. (*longispinus*, Targ.) and its natural enemies were dusted or sprayed with talc or with 12·5 per cent. DDT in talc on 11th March 1946 or left untreated, and were examined for infestation at monthly intervals until July. By April, treatment with DDT had greatly reduced the mealybug population and eliminated the predators, which did not reappear until June, but the percentage parasitism increased each month from April to July and mealybug populations each month from May to July. Treatment with talc alone did not reduce the percentage parasitism, but virtually eliminated increase in predators during April and May, when great increases in mealybug populations occurred. On untreated trees, predators increased rapidly, mealybug populations decreased and parasitism remained fairly constant during May and June. It appeared therefore that predators were primarily responsible for the decline of the mealybug populations under natural conditions during the period and that parasitism was relatively unimportant.

In the other test, DDT (2 or 4 lb. per acre) was applied as a spray on 16th July 1946 in plots in a navel-orange grove in which a heavy infestation of *Icerya purchasi*, Mask., had developed and the population of the predacious Coccinellid, *Rodolia cardinalis*, Muls., had begun to increase. The DDT had little effect on the scale but eliminated the predator, and no reductions in scale population had occurred by 21st August on the treated plots, although the DDT had become ineffective and some adults and a few young larvae of *R. cardinalis* were again present, whereas populations of *Rodolia* on untreated trees increased very rapidly and practically no living scales could be found on 21st August.

The possibility of using other insecticides for similar tests is discussed and the limitations of the method, including the possibility that residues non-toxic to the host may make conditions more favourable for its increase apart from the destruction of natural enemies, are pointed out.

Potts (S. F.). **Particle Size of Insecticides and its Relation to Application, Distribution, and Deposit.**—*J. econ. Ent.* **39** no. 6 pp. 716-720, 2 refs. Menasha, Wis., 1946.

The following is based chiefly on the author's summary. Particle size is an important factor in determining deposit, distribution and effectiveness of dusts and concentrated sprays. A field of resistance surrounds all objects, including plants and insects, and repels most individual dust particles of small size and droplets smaller than approximately 30 microns in diameter.

Ordinary dust clouds consist of a mixture of individual particles and agglomerates of many particles, and if the particles are small, the deposit on insects and plants consists almost entirely of agglomerates. If clouds of finely atomised oil and dust are mixed at normal pressure, the oil coats only a small proportion of the dust particles, but if the oil is atomised by the force of a stream of compressed air containing the dust, at a pressure of 15 lb. per square inch or more, a fairly good coating is obtained. The coated particles coalesce into groups and adhere to foliage better than uncoated ones.

With concentrated sprays, fine atomisation is necessary for adequate distribution of the small quantities used, but the droplets must be large enough to

give a satisfactory deposit on foliage and insects. Apparently most of the spray should be in droplets 30–80 microns in diameter for application from the ground, and 70–100 microns on large flat areas or 100–300 microns against certain forest insects on rugged terrain for application from aircraft. The numbers of droplets that would be deposited per sq. mm. or sq. in. if 1 U.S. gallon liquid were evenly distributed in droplets of given sizes over an acre of surface are shown in a table.

Other factors affecting particle or droplet size are type of distributing device, concentration, density and type of insecticide, rate of volatilisation of the ingredients, distance to which the particles must be drifted, wind and other meteorological factors, volume and compactness of foliage and settling rate.

BACK (E. A.). **Protection of Mohair Fleeces in Storage from Moths by dipping Goats before Shearing.**—*J. econ. Ent.* **39** no. 6 pp. 721–723. Menasha, Wis., 1946.

Most American wool and mohair fleeces are not used until about two years after shearing and insects, especially *Tineola biselliella*, Humm., *Tinea pellionella*, L., and more rarely *Tineola columbariella*, Wocke, cause persistent and sometimes serious damage to them during this period. As it is difficult to treat the fleeces while they are packed in sacks or bales awaiting manufacture, several solutions containing DDT were used as dips for Angora goats in Texas in March and August 1944, four days before shearing in each case, and the fleeces sent to Washington to be tested for resistance to insect attack. The dips used contained DDT, diethyl phthalate, Triton 720 (sodium salt of an aralkyl polyether sulphonate) and water (20 : 35 : 20 : 25) or DDT and soluble pine oil (1 : 5), both diluted with water to contain 0·2 per cent. DDT, and one of 10 lb. wettable sulphur per 100 U.S. gals. water was also tested. Fleeces from dipped animals were compared with those from untreated ones and with mohair sheared and scoured about ten years previously. Larvae of *Attagenus piceus*, Ol., and *Anthrenus vorax*, Waterh., were the test insects, since material resistant to them is also resistant to moths, whereas the reverse may not be true. The samples were exposed to batches of 25 larvae in petri dishes in two series of tests, from 22nd September to 31st December 1944 and from 3rd February to 7th March, 1945.

Visual examination of the mohair and measurement of the weight of frass produced by the larvae showed that the DDT dips gave excellent protection, whereas the sulphur dip had no value. The average weight of frass per 25 larvae ranged from 1·6 to 8·4 mg. among those that were exposed to DDT and from 85·4 to 206·3 mg. among those that were not.

The tests in 1945 were with larvae that were ready to pupate, and, at the end of the month's exposure, there were more living and more dead larvae in the samples treated with DDT, and more pupae and adults in the other samples. The insects in the latter were normal in all respects, but the living larvae in the DDT samples were stunted and weak, most of the pupae and adults were dead, and none of the surviving adults laid eggs. In no test of mohair from animals dipped in DDT did larvae remain alive for months, as they did when confined with untreated material.

OSBORN (H. T.) & PHILLIPS (G. R.). *Chilo loftini* **in California, Arizona, and Mexico.**—*J. econ. Ent.* **39** no. 6 pp. 755–759, 1 fig., 6 refs. Menasha, Wis., 1946.

The following is taken from the authors' summary. *Chilo loftini*, Dyar, a stem borer recognised as a sugar-cane pest in Mexico [*cf. R.A.E.*, A **14** 540; **18** 576], was reported for the first time from California on 28th November

1944 [**34** 375], when it was found in sugar-cane and rice stubble in the vicinity of Calexico. It had previously been reported from the United States as attacking random plants of sugar-cane in Arizona [**11** 322].

Plant quarantine records show that *Chilo loftini* and *Chilo* sp. have frequently been intercepted in California and Arizona at ports of entry on the Mexican border.

According to survey records covering the period from November 1944 to April 1945, the heaviest and most extensive infestation in California occurred within the irrigated section of the lower Imperial Valley, where immature forms of the moth were found in rice, sorghum, sugar-cane, maize and barley, as well as in several grasses. It apparently caused no appreciable reduction in either the rice or the sorghum crop, harvested in December 1944, in the Calexico-El Centro section of the Valley. Light infestations were reported from widely separated localities in Riverside County.

Surveys in Arizona and Mexico in areas adjacent to California revealed only localised infestations of *C. loftini*, the most severe occurring in Arizona in sorghum west of San Luis. Sorghum was the only cultivated plant found infested in Mexico.

Jones (P. R.), Glover (L. C.) & Hansberry (R.). **An Oil-DDT Vapor Spray to control Grape Leafhopper.**—*J. econ. Ent.* **39** no. 6 pp. 770–774, 1 fig. Menasha, Wis., 1946.

An account is given of experiments in 1944–45 in which vaporised sprays of DDT in a base oil consisting of a highly refined kerosene and a light spray oil (9 : 1) were compared with similar sprays of 3 per cent. pyrethrum extract in the same base (0·046 per cent. pyrethrins) for the control of grape leafhoppers in California and Arizona. The prevalent species in the San Joaquin Valley of California was *Erythroneura elegantula*, Osborn [*cf. R.A.E.*, A **35** 111], but both *E. variabilis*, Beamer, and *Dikraneura cockerelli*, Gill., were present in the Salt River Valley in Arizona. The sprays were applied with vapour spray machines, or modifications of them, modified dusters and the Todd Insecticide Fog Applicator [**35** 259], which was used in Arizona [**34** 262] and did not give such lasting results as the other types.

In preliminary experiments in the San Joaquin Valley in 1944, vaporised sprays containing 0·05–2·4 per cent. DDT applied to grape vines in spring when new growth was 8–24 inches long and only overwintering adults and a few eggs were present, gave no immediate knock-down such as occurred with pyrethrum, but concentrations of 0·6, 1·2 and 2·4 per cent. DDT gave complete control of adults and nymphs [*cf.* **35** 111], though these were common on the pyrethrum plots. Very little infestation occurred later in the season, even on new growth.

In further experiments in 1945 in the San Joaquin and Coachella Valleys in California and the Salt River Valley in Arizona, vapour sprays of 0·6, 1·2 and 2·4 per cent. DDT and the pyrethrum spray were applied at rates of 3–5 U.S. gals. per acre to about 15,000 acres of vines. Counts made two days or less before treatment and 2–5, 30, 60 and 90 days after it showed that in practically every case treatment with DDT gave more than 99 per cent. control of the adults and prevented the development of nymphal populations for several weeks. Nearly all the vines were treated before they flowered, but a few that were treated after flowering had residues on the mature grapes that ranged up to 3·5–5·8 parts DDT per million for the highest concentration of DDT. The predacious Coccinellid, *Hippodamia convergens*, Guér., and the Mymarid egg parasite, *Anagrus epos*, Gir., were numerous on vines sprayed with DDT, there was no apparent difference in infestation by *Tetranychus willamettei*, McG., at the end of the season on blocks treated with DDT or pyrethrum, and no foliage injury due to DDT was observed.

When sprayed foliage was caged and successive lots of adult leafhoppers left in the cages for a week, the residue from the vaporised sprays still showed considerable toxicity after 82 days. Ordinary sprays consisting of emulsified solutions of DDT in emulsive summer oils gave even better results but were applied heavily and would probably not be economic in California.

PLUMMER (C. C.) & BAKER (E. W.). **The Effect of sublethal Dosages of Tartar Emetic on the Mexican Fruitfly.**—*J. econ. Ent.* **39** no. 6 pp. 775–780, 7 refs. Menasha, Wis., 1946.

Populations of *Anastrepha ludens*, Lw., on *Citrus* in Mexico can be considerably reduced by the application of sweetened bait-sprays containing tartar emetic [*cf. R.A.E.*, A **32** 276; **33** 397], but as it is likely that many of the flies ingest only sub-lethal amounts, laboratory experiments were carried out to determine the effect of such dosages on them. Flies 21–31 days old at the beginning of the experiment were kept in batches of 25 of each sex at 25°C. [77°F.] and about 60 per cent. relative humidity and allowed constant access to aqueous solutions of 20 lb. sugar alone or with 4 oz. casein per 100 U.S. gals. from 14th August to 19th October or of 20 lb. sugar, 4 oz. casein and 1 or 0·5 oz. tartar emetic per 100 U.S. gals. from 14th August to 31st August, after which tartar emetic was eliminated from their food on account of excessive mortality. A hollow section of skin from a partly ripe peach from which all food was removed was left in each cage from 11.30 a.m. until 6 p.m. each day for egg deposition, after which the eggs were removed and kept at 25°C. Eggs deposited on the cages were disregarded. The mortality of flies was recorded when the fruit sections were introduced and removed, and dead flies were replaced with living ones that had received the same treatment. Flies caged with the stronger tartar-emetic solution deposited eggs, some of which were viable, from 14th August to 4th September, but not again during the experiment, and those caged with the weaker solution oviposited from 14th August to 19th September and again on 13th–19th October, whereas those with sugar only or sugar and casein only oviposited practically throughout the period of experiment and laid significantly more eggs. The percentage hatch of eggs was lower and the percentage of collapsed eggs higher when tartar emetic was included in the diet. In general, the addition of casein to the sugar diet had little or no effect on the number and viability of the eggs deposited.

In a second experiment, the amounts of tartar emetic included with sugar and casein were reduced to 0·25 and 0·125 oz. and essentially similar results were obtained from these two diets, although the reduction in the number of eggs deposited was not so marked as with the diet containing 1 oz. tartar emetic.

It is considered likely that the ingestion of small amounts of tartar emetic may have been a factor in the general reduction of the population of *A. ludens* on *Citrus* in the vicinity of Hacienda de Santa Engracia, Tamaulipas, Mexico, where sprays were applied in each of the years 1936–42.

FULTON (B. B.). **Soil Insecticides for Control of the Southern Corn Rootworm.**—*J. econ. Ent.* **39** no. 6 pp. 781–783, 1 fig. Menasha, Wis., 1946.

In small-plot experiments in North Carolina in 1946 on the control of larvae of *Diabrotica duodecimpunctata*, F., seeds of hybrid sweet maize were planted on 6th or 16th April in hills prepared by stirring 1 or 5–7 gm. 3 per cent. DDT dust or 5–7 gm. of a dust containing 85 per cent. sulphur and 4·7 per cent. benzene hexachloride (0·8 per cent. γ isomer in the prepared dust) into the soil of each hill with a hoe or were coated with 3 per cent. DDT dust and planted in untreated soil. Four seeds per hill were used on hills 2 ft. apart, and the seed put in the treated soil was covered with it. Germination was uniform, and there was little difference between treated and untreated plants until they

were about 2 ins. high, after which injury by the larvae noticeably retarded growth in untreated plants, many being killed while small. A much smaller proportion of treated plants was injured. The average numbers of uninjured plants per hill on 11th May and the percentages of hills on 11th June with one or two good plants that appeared likely to produce ears were, respectively, 2·7–3·2 and 88–99 for 5–7 gm. DDT dust, 2·7 and 100 for 1 gm. DDT dust, 2·4 and 88 for benzene hexachloride, 1·9 and 63 for seed coated with DDT and 0·7–1·8 and 33–62 for no treatment.

In another experiment, maize that was sown in hills on 13th May, when no more injury by *Diabrotica* was expected, but showed signs of injury soon after it came up, was treated with suspensions (5 gm. per litre) of a wettable powder containing 50 per cent. DDT or of a powder containing 50 per cent. benzene hexachloride and 5 per cent. γ isomer, which were either injected into the soil round the roots of the plants at the rate of 100 cc. per hill or sprayed on the surface of the soil about the plants in a solid stream for a few seconds, using about 50 cc. per hill. The percentages of plants showing injury by the larvae on 7th June were 6·1 and 11·2 for DDT, injected and used on the surface, respectively, and 6·4 and 11·9 for benzene hexachloride, as compared with 17·7–36·1 for no treatment. No plant injury due to the insecticides was observed in any of these experiments, but, in another locality, field maize planted in soil treated with the benzene-hexachloride mixture used in the first test showed definite injury.

In an experiment on the effects on the plants of the dust of sulphur and benzene hexachloride, a similar dust in which the sulphur was replaced by pyrophyllite and the content of benzene hexachloride was higher (8 per cent.) though the γ isomer content was the same, sulphur alone and 3 per cent. DDT, used as in the first test and also at double the rate, hybrid sweet maize and field maize were planted in treated soil on 18th June and examined ten days later. The percentage germination was 97 for no treatment, 95 for the double dosage of DDT and 98 for the single dosage of DDT and for sulphur at both rates. All rows treated with benzene hexachloride showed definite signs of insecticide injury, the plants averaging less than half the size of those receiving other treatments, and although most of the seeds had germinated, the number of plants above ground varied from 71 to 83 per cent. of the number of seeds planted, indicating that benzene hexachloride is toxic to young maize under some conditions, although it is not known what these are. DDT is apparently much safer, but further experiments with benzene hexachloride may show that effective control of *D. duodecimpunctata* can be obtained with dosages that are safe for the plants.

Newcomer (E. J.) & Dean (F. P.). **Effect of Xanthone, DDT, and other Insecticides on the Pacific Mite.**—*J. econ. Ent.* **39** no. 6 pp. 783–786, 1 fig., 3 refs. Menasha, Wis., 1946.

The results are given of investigations carried out in Washington in 1943–45 on the effect of sprays on *Tetranychus pacificus*, McG., on apple ; they indicated that infestation is reduced by xanthone [*cf. R.A.E.*, A **31** 500], increased by DDT, and not affected by lead arsenate, cryolite or nicotine bentonite. The trees received a calyx spray of 2 lb. lead arsenate per 100 U.S. gals. and 6–7 cover sprays of the test materials. When the figures for the three years were averaged, there was practically no difference in the degrees of infestation recorded in August for sprays of 3 lb. lead arsenate, cryolite (90 per cent.), or nicotine bentonite (1 : 5) per 100 U.S. gals., the first two with 2·67 oz. colloidal spreader and the third with 0·25 U.S. pint oleic acid and 2 oz. aluminium sulphate and all with 1–2 U.S. quarts mineral oil, but sprays of 2 lb. xanthone, 1 U.S. quart kerosene or stove oil and 8 oz. colloidal spreader per 100 U.S.

gals. following two cover sprays of nicotine bentonite gave a lower average figure. In 1944, unsprayed trees had a slightly higher average infestation than those sprayed with cryolite, lead arsenate or nicotine bentonite in the same orchard, indicating that the mineral oil used with these materials had some effect on the mites, though it did not materially reduce the infestation. There were never enough mites on the trees sprayed with xanthone to cause any damage to the crop.

Continued use of DDT resulted in a striking increase in infestation, even when 1 quart mineral oil per 100 gals. spray was added. In 1945, when the quantity of DDT was increased from 8 oz. to 2 lb. per 100 U.S. gals., infestation was somewhat less, but still heavy, and 4 oz. DDT dissolved in 2 U.S. quarts oil per 100 U.S. gals. also resulted in heavy infestation, but the addition of 8 and 5·3 oz. of a dicyclohexylamine salt of dinitro-o-cyclohexylphenol (20 per cent.) to the fourth and fifth cover sprays, respectively, of a schedule of 8 oz. DDT and 1 lb. pyrophyllite per 100 U.S. gals. kept the mites at a minimum. The addition of 4 oz. DDT per 100 U.S. gals. to half-strength sprays of the other four insecticides resulted in a heavier infestation than when the latter were used alone, but did not result in high infestations when the other insecticide was xanthone. Apparently, the DDT killed or prevented the development of predators, particularly *Stethorus picipes*, Casey.

It was shown in 1945 that heavy infestations of mites before the end of August caused smaller apples, no doubt by interfering with the normal functioning of the leaves, and they probably also resulted in reduced colour, though there was too much variation in colour in the orchards for a reliable estimate to be made.

It is concluded that if DDT were used against the codling moth [*Cydia pomonella*, L.] on apple in areas infested with *T. pacificus*, xanthone should be added after the second cover spray; if it is used in the first two sprays it russets the fruit of Jonathan apples and of yellow varieties. Control of the mite could also be obtained by adding a dinitro salt to two or more of the cover sprays if further tests of this material show it to be safe; it caused slight foliage injury in 1945.

Satterthwait (A. F.). **Sunflower Seed Weevils and their Control.**—*J. econ. Ent.* **39** no. 6 pp. 787–792, 5 refs. Menasha, Wis., 1946.

Sunflowers were formerly grown for oil in Missouri, Illinois and the San José Valley, California, but production in the first two States was almost entirely discontinued, chiefly owing to infestation of the seed by the weevils, *Desmoris fulvus*, Lec., and *D. constrictus*, Say, until war needs revived interest in the crop. *D. fulvus* has been recorded from Illinois to California and *D. constrictus* from New Jersey to California. They have one generation in the year and, in Illinois, they appear almost simultaneously in midsummer as adults on the new crop of sunflowers. Their life-history was studied in south-eastern Missouri and central Illinois. Adults of *D. fulvus* were found only on plants of the genus *Helianthus*, including Jerusalem artichoke [*H. tuberosus*] and occurred on sunflower from 17th July to 29th September. They punctured the sunflower seeds and fed on the kernels. The eggs were deposited singly in some of the excavations, and the larvae fed in them. The larval stage lasted about ten months. Some larvae left the achenes, leaving conspicuous holes, and went into the soil before harvest, whereas others remained in them until the following spring or early summer. They usually pupated in the soil, the pupal stage lasting about eight days. Adults of *D. constrictus* were taken from 28th June to 21st September. They were much less common on commercial sunflowers than those of *D. fulvus*. The larvae left the achenes and entered the soil as early as 13th August, but some remained alive throughout the winter in the achenes of hybrid sunflowers, and almost all the larvae overwintering in

the latter seemed to be *D. constrictus*. No larvae found in wild sunflower seeds were successfully reared, but the adults of the two species were associated on the flower heads, and it may be assumed that both breed in the seeds.

Bracon (*Microbracon*) *mellitor*, Say, was frequently reared from larvae of *D. fulvus* in one locality in Illinois [*cf. R.A.E.*, A **21** 471]. Experiments on control with dusts gave unfavourable results in 1934 and 1935, as also did handpicking. Autumn ploughing and crop rotation might give some control, and the development of hybrid strains of medium height and with a short uniform blooming period might make insecticidal treatment practicable. As apparent resistance to attack was observed in some plants, experiments to find and develop resistant strains with other desirable qualities were carried out in 1936–40. Tests with strains from many countries were made in widely separated areas in Illinois, and the methods included sibbing and selfing under control and comparing rates of infestation from generation to generation and in covered and uncovered portions of individual heads. Infestations of 5 to 100 per cent. of the plants and of less than 1 to 75 per cent. of the seed were observed. Seven of the strains that were developed by sibbing and selfing appeared to be relatively resistant, and two definitely so.

Nickels (C. B.) & Pierce (W. C.). **Effect of Lead Arsenate Sprays on the Pecan Weevil and other Pecan Insects.**—*J. econ. Ent.* **39** no. 6 pp. 792–794. Menasha, Wis., 1946.

Investigations were carried out in Texas in 1943–45 on the value of sprays of lead arsenate and cryolite in controlling *Curculio caryae*, Horn, on pecan. Large numbers of adults emerge in late August or September after periods of heavy rainfall, and when nuts were being punctured for oviposition at such times, ten trees were jarred to determine the numbers of weevils that had emerged. Spraying, at a pressure of 500–600 lb. per sq. inch, was begun when many weevils had emerged but few eggs had been laid, and a second application was usually made about ten days later. Preliminary cage tests in 1943 indicated that lead arsenate had considerable toxicity to the weevils. In 1944, sprays of 3 lb. lead arsenate, 3 lb. lime and 1 lb. zinc sulphate per 100 U.S. gals. and of twice these amounts increased mortality of weevils on caged branches from 13 to 79 and 99 per cent. and reduced the numbers of feeding punctures from 271 to 71 and 8, respectively, when applied on 13th September. In similar tests in 1945, applications of the double-strength spray on 4th and 14th August increased mortality from 8 to 26 and from 32 to 71 per cent. and reduced the numbers of feeding punctures from 40 to 12 and from 53 to 16, respectively. The sprays appeared to repel the weevils.

In field experiments in 1943, when infestation was heavy, sprays of 6 lb. cryolite and 2 U.S. quarts oil emulsion per 100 U.S. gals. and of 6 lb. lead arsenate per 100 U.S. gals., applied twice in September, reduced the percentages of nuts punctured during the season from 79·5 to 73·2 and 46·1 on one variety and from 62·4 to 49·5 and 22·7 on another, and the percentages of harvested nuts infested from 66·6 to 63·9 and 32·5 on the first variety and from 49·8 to 39·4 and 21·5 on the other, respectively. Since cryolite appeared to have little value, further experiments were restricted to lead arsenate. In 1944, when infestation was light to medium, the single- and double-strength sprays of lead arsenate, lime and zinc sulphate reduced the percentages of nuts punctured during the season from 24·2 to 8·2 and from 56·1 to 16, respectively, and the percentages of harvested nuts infested from 15·9 to 6·3 and from 36·8 to 10·1, and in 1945, under conditions of heavy infestation, the double-strength spray with the addition of 1 U.S. quart oil emulsion per 100 U.S. gals. reduced the percentages of harvested nuts infested from 50·5 to 7·5 on one variety and from 79·2 to 37·2 on another. In 1943, when humid conditions followed the application of the spray, lead arsenate alone caused slight injury to several

pecan trees, but in 1944 and 1945, lead arsenate, lime and zinc sulphate caused no injury. However, this treatment is probably unsafe on pecan foliage except in arid or semi-arid climates.

Counts of the numbers of *Myzocallis* (*Monellia*) sp. in 1945 showed averages of 32·5 Aphids per leaflet on untreated trees and 112·7 on those treated with lead arsenate nine days before, the difference being highly significant, and it is concluded that nicotine sulphate may be needed in weevil sprays to avoid an increase in Aphid populations. Two applications of the lead-arsenate sprays in September resulted in large reductions in the abundance of the overwintering generation of *Acrobasis caryae*, Grote, in all three years.

EBELING (W.). **Sub-soil Bark Injury from Kerosene Spray.**—*J. econ. Ent.* **39** no. 6 pp. 795–797, 1 graph, 2 refs. Menasha, Wis., 1946.

Although sprays containing kerosene have been used on *Citrus* in California [*cf. R.A.E.*, A **34** 79, etc.] without the adverse effect on the trees caused by the heavier fractions of petroleum oil, the kerosene has injured the bark just below the soil surface when the spray has run down the trunks. This type of injury was first observed when sprays containing 10 per cent. kerosene were used and was avoided by making a mound of soil round the trunk just before spraying and removing it soon after, but it has since occasionally been caused by 3 per cent. sprays if the soil round the trunk was depressed. Since similar injury is very rarely caused by light-medium oil, it was presumed that it increases with decreasing heaviness of the petroleum fraction and that the lighter of the fractions in commercial kerosene might account for a large part of it. To determine the relation between distillation range and injury to sub-soil bark, trees with the earth round them formed into a basin were sprayed at an excessive rate with 10 per cent. kerosene (distillation range 260–595°F.) and with 10 per cent. of fractions with ranges of 260–352, 336–408, 355–440, 396–430, 425–460, and 450–496°F. on 4th January 1946. Examination on 17th June showed that the percentages of the circumference of the trunk injured below the original soil line averaged 58 for the kerosene and 100, 95, 65, 30, 6 and 0 for the six fractions, the amount of injury decreasing with each increase in heaviness of the fraction and being very slight in those with initial boiling points of 425°F. or higher, even under these conditions of heavy application.

In another test in which 10 per cent. concentrations of the heaviest and lightest fractions were poured into basins surrounding the trees, the former caused no injury, whereas the latter completely girdled the trunks. Trees round which basins had been formed were sprayed on 18th December 1945 with 3 per cent. kerosene consisting of equal parts of fractions with distillation ranges of 382–432, 396–430, 406–447, 425–460, 437–476 and 450–496°F., and examined on 17th June 1946; no evidence of bark injury was found, and it is considered probable that a kerosene with an initial boiling point above 375°F. used at a concentration of 3 per cent. would give a good margin of safety.

BRUNSON (M. H.). **The Oriental Fruit Moth on Nursery Stock.**—*J. econ. Ent.* **39** no. 6 pp. 797–800. Menasha, Wis., 1946.

Investigations were carried out in New Jersey and Maryland in 1944 and 1945 to ascertain whether *Cydia* (*Grapholitha*) *molesta*, Busck, could hibernate successfully on nursery stock and be transported on it to new areas. The following is based largely on the author's summary. When the plants were examined in August and September, larvae were found feeding in succulent twigs of peach and in those of ornamental peach, almond, quince and cherry, but not in those of commercial apple or ornamental crab apple trees. Larvae were found in the fruits of ornamental crab apple and quince, but not in those

of several other ornamental plants. Hibernacula occurred naturally on peach and moths were reared from hibernacula on peach stock stored over winter in a commercial frost-proof storage chamber, though only a small proportion survived commercial handling. Moths began to emerge from hibernacula on twigs in a frost-proof chamber between 30th April and 7th May 1945, but this was probably abnormally early owing to mean daily temperatures of 50·5 and 55·5°F. in March and April, the normal temperatures being 39·8 and 50·5°, respectively. Eggs of *C. molesta* were not deposited on peach stock heeled in between 14th and 28th April 1945 in infested peach orchards and neighbouring fields. Very few eggs were deposited by unfertilised females, and none of them hatched.

Complete evidence of survival through the winter was obtained only on peach nursery stock, but the negative results obtained in some cases have little significance because of the lightness of the infestation in most of the nurseries in which the observations were made, and it may be assumed that a certain proportion of the larvae feeding in the twigs or fruit of any plant will form their cocoons on it.

Wilson (H. F.), Allen (N. N.), Bohstedt (G.), Betheil (J.) & Lardy (H. A.). **Feeding Experiments with DDT-treated Pea Vine Silage with special Reference to Dairy Cows, Sheep, and Laboratory Animals.**—*J. econ. Ent.* **39** no. 6 pp. 801–806, 2 graphs, 5 refs. Menasha, Wis., 1946.

The results are given of experiments carried out in Wisconsin between November 1945 and April 1946 to determine the effect of feeding cattle and sheep on silage prepared from pea plants treated with DDT. In the first test, a DDT dust was added to the chopped vines as they were put into the silos, at the calculated rate of 227 mg. DDT per lb. green silage. The DDT concentration was determined as 49 mg. per lb. silage when feeding was begun and as 74 mg. per lb. in the silage taken from the bottom of the silo at the end of the experiment. Dairy cows and sheep showed no ill effects when fed for 4–5 months on this silage, and suckling calves and lambs showed none, although 15 parts per million of DDT were present in the cows' milk. Laboratory analysis of the body parts of one cow and one calf showed 3·8 and 3·1 p.p.m. DDT in the muscle tissues, 6·1 and 6·2 p.p.m. in the liver and 221 and 305 p.p.m. in the body fat, and ewes showed 1 p.p.m. DDT in the muscle tissue and 18–145 p.p.m. in the body fat, and their sucklings up to 1 p.p.m. in the muscle and 43 p.p.m. in the body fat.

In the second test, the plants were dusted when 14 inches high with 5 per cent. DDT at the rate of 40 lb. per acre, which was estimated to result in 38 mg. DDT per lb. silage, but when the silage was analysed in December 1945, less than 1 p.p.m. [0·454 mg. per lb.] was found. Cows fed for 4–5 months on this silage were not affected, and no DDT was found in the milk.

A cow that ingested 24 gm. DDT per day in grain for five months showed no ill effects, but its fat contained 380 p.p.m. DDT and its milk 44 p.p.m. Laboratory rats fed on milk containing 44 p.p.m. DDT showed distinct toxic effects, but those fed on milk containing only 15 p.p.m. showed none.

Wilson (H. F.), Srivastava (A. S.), Hull (W. B.), Betheil (J.) & Lardy (H. A.). **DDT Residues on Pea Vines and canned Peas from Fields treated with DDT Dusts.**—*J. econ. Ent.* **39** no. 6 pp. 806–809, 2 refs. Menasha, Wis., 1946.

Analysis of the amount of DDT on pea plants, mainly from two localities in Wisconsin, that had been dusted at 35–50 lb. per acre for the control of the pea Aphid [*Macrosiphum onobrychis*, Boy.] in June showed residues of 3, 0–2,

and 3–5 parts per million immediately after treatment with 1, 2 and 3 per cent. DDT, respectively. Plants treated with 5 per cent. DDT showed 2–13 p.p.m. immediately after treatment, 3–4 p.p.m. at harvest and 5–7 in silage 3–4 months after treatment. No DDT was found in peas shelled in the field at the time of cutting or in canned peas. Some of the samples were taken from plots on which various insecticides were tested against the Aphid; control of the order of 90 per cent. was obtained 3–4 days after application from dusts of 0·75 per cent. rotenone, 2·5, 3 or 5 per cent. DDT, 5 per cent. benzene hexachloride, 0·25 per cent. rotenone with 2 per cent. DDT or benzene hexachloride, or 0·5 per cent. rotenone with 1 per cent. DDT, and rather less from 0·25 per cent. rotenone. The DDT dusts still maintained good control 9–10 days later, but rotenone and benzene hexachloride were showing a loss of effectiveness.

Brett (C. H.). **Repellent Properties of Extract of *Amorpha fruticosa*.**—*J. econ. Ent.* **39** no. 6 p. 810, 2 refs. Menasha, Wis., 1946.

In further tests in Oklahoma of the repellent properties of an acetone extract from the fruit of *Amorpha fruticosa* [*cf. R.A.E.*, A **36** 9–10], less than 33 per cent. of about 2,000 nymphs and adults of *Blissus leucopterus*, Say, that were enclosed by barriers of the standardised dust [*cf. loc. cit.*] had crossed the barriers at the end of ten hours, and 20 per cent. of those that crossed were dead at the end of 24 hours, as compared with 15 per cent. of untreated insects. There was no repellency after 24 hours. In comparative tests, 5 per cent. DDT dust in the barriers killed 16 per cent. of the bugs by the end of 24 hours, nearly all having crossed at the end of 15 minutes, 4 per cent. DN dust [? dinitro-o-cresol (*cf.* **34** 250)] killed over 90 per cent. by the end of six hours, but showed no repellent effect, and 10 per cent. sabadilla dust was not repellent, but affected the bugs so quickly that 30 per cent. died without being able to cross the barriers and all were dead within an hour. Laboratory tests showed the *Amorpha* extract to be very repellent to *Diabrotica melanocephala*, F. (*vittata*, F.) for more than 12 hours, and infested garden plants treated with the dust were freed of beetles; dead insects were not found, and subsequently laboratory tests showed the dust to have little toxic effect. The extract was not appreciably repellent to mosquitos.

Walnut-shell flour impregnated with extract retained its darker colour, repellency, toxicity and odour for long periods when refrigerated in tightly closed bottles, but lost them in about 24 hours when exposed to air.

S. A. McCrory has reported that caterpillars refused to remain on cabbage plants sprayed with acetone extract of *Amorpha*, but that the moths oviposited as readily on treated plants as on untreated ones and the larvae hatching from their eggs were unaffected and devoured the treated plants completely.

Fayette (L. J.), Hensill (G. S.) & Cassil (C. C.). **Hexaethyl Tetraphosphate for Control of Mites.**—*J. econ. Ent.* **39** no. 6 p. 812, 1 ref. Menasha, Wis., 1946.

In investigations in California on the control of *Tetranychus bimaculatus*, Harvey, on rose bushes with hexaethyl tetraphosphate, a commercial preparation containing 50 per cent. of the compound, used at 1 pint per 100 gals., was applied on 13th and 24th June. Counts of mites on samples of leaves made immediately before and 24 hours after each application and on 5th July, showed populations of 52·24 and 0·45, 5·52 and 0·04, and 0·07 living mites per leaf, respectively, the difference between the last two being insignificant. The first application killed 98·6 per cent. of the mites, and most of those found alive at subsequent counts had hatched from eggs present in the original population. The newly hatched mites were killed by the second spray application before they had reached maturity.

MICHELBACHER (A. E.), SWANSON (C.) & MIDDLEKAUFF (W. W.). **Increase in the Population of *Lecanium pruinosum* on English Walnuts following Applications of DDT Sprays.**—*J. econ. Ent.* **39** no. 6 pp. 812–813. Menasha, Wis., 1946.

A spray consisting of 5 lb. of a wettable powder containing 20 per cent., DDT with 0·33 U.S. gal. light medium oil emulsion and $\frac{1}{3}$–$\frac{1}{2}$ lb. colloidal DDT depositor of unstated composition per 100 U.S. gals., applied to English walnut trees in California at the rate of about 55 U.S. gals. spray per tree and a pressure of 600 lb. per sq. in. on 4th and 31st May 1945, or on the first date only, gave excellent control of the codling moth [*Cydia pomonella*, L.] and also controlled the Aphid, *Chromaphis juglandicola*, Kalt. [*cf. R.A.E.*, A **34** 309], but resulted in a considerable increase in the mite population later in the season. The control of the Aphid and the increase in mites were both greater when the sprays were applied on a commercial scale than when they were applied to single trees in a replicated experiment. Examination of the trees on 10th May 1946 showed that those that had received DDT were much more heavily infested by the Coccid, *Eulecanium* (*Lecanium*) *pruinosum*, Coq., than the others, the numbers per twig being 7·5 and 6 for one and two sprays on a commercial scale and 2·1 and 1·8 for one and two sprays on single trees, compared with 0·54 and 0·37 on untreated trees.

JEPPSON (L. R.). **Di(4,Chlorophenoxy) Methane for Control of Citrus Red Mite.**—*J. econ. Ent.* **39** no. 6 p. 813. Menasha, Wis., 1946.

In laboratory tests begun in California in March 1945, di(4-chlorphenoxy)-methane, which is soluble at approximately 4 per cent. in kerosene or the regular spray oils and up to 30 per cent. in Velsicol AR-60 and similar aromatic solvents, consistently gave complete kill of eggs of *Paratetranychus citri*, McG., when a solution was diluted to give a spray containing $\frac{3}{4}$ lb. or more per 100 U.S. gals. water. When dissolved in kerosene or Velsicol AR-60 and applied at 1 lb. per 100 U.S. gals. diluted spray, it gave complete mortality of mites that were transferred to *Citrus* fruits 60 days after they had been sprayed in insectary tests and 10–30 days after spraying in the field. The results obtained suggest that the toxicity of the deposit is more persistent in winter than in summer.

Large-scale applications of emulsified solutions in 1945 and 1946 resulted in no spray injury to *Citrus* trees, and 1 per cent. sprays were comparable with oil sprays and more consistent than sprays containing DN–111 (20 per cent. of a dicyclohexylamine salt of 2,4-dinitro-6-cyclohexylphenol) for mite control. Although spray suspensions or dusts containing di(4-chlorphenoxy)methane are less toxic to the eggs of *P. citri* than kerosene emulsions, field tests indicated that the deposits have sufficient toxicity to prevent the development of mites that hatch after application. Sprays containing 1 lb. of the compound per 100 U.S. gals. and dusts containing 4 per cent. or more gave satisfactory control in preliminary field tests.

KARTMAN (L.). **A new Host for *Cybocephalus* sp., a Predator of Diaspine Coccidae.**—*J. econ. Ent.* **39** no. 6 p. 814, 8 refs. Menasha, Wis., 1946.

Nitidulids of the genus *Cybocephalus* occur throughout the subtropical and tropical regions of the world, feeding mainly on Diaspine Coccids and Aleurodids. It is possible that two indigenous species [*cf.* also *R.A.E.*, A **34** 145] are present in the United States. *C. californicus*, Horn, is reported from the south-west and has been collected in California from Yuba County to San Diego County, and *C. nigritulus*, Lec., occurs in the south-east. The taxonomy of the genus

is confused, however, and it has been suggested that the types of *C. californicus* and *C. nigritulus* may be opposite sexes of the same species.

In April 1942, beetles determined as *Cybocephalus* sp., possibly *C. californicus*, were observed feeding on *Nilotaspis halli*, Green, on heavily infested almond trees at Chico, California. They were little larger than the Coccids and sought these out in crevices in the bark. Gravid females appeared to be the most attractive, and crawlers were ignored. Twelve adults of *Cybocephalus* that were confined singly on squares of bark, each with ten living adult females of *N. halli*, consumed an average of 7·08 each in about 36 hours. Field observations indicated that the beetles were confined mainly to the older parts of the tree in rough bark, and their frequency varied directly with that of the scale. They were present in very small numbers, averaging about 0·4 and 3·4 per tree for lightly and heavily infested trees, respectively.

McLeod (W. S.). **Effect of Hexachlorocyclohexane on Onion Seedlings.**—*J. econ. Ent.* **39** no. 6 p. 815, 1 ref. Menasha, Wis., 1946.

Since treatment of onion seed with an equal weight of 20 per cent. crude benzene hexachloride (hexachlorocyclohexane) for the control of the onion maggot [*Hylemyia antiqua*, Mg.] in Winnipeg killed the seedlings [*R.A.E.*, A **36** 90], greenhouse tests were carried out in 1946 to observe the effect of the compound on onion seedlings. A dust of 20 per cent. benzene hexachloride in gypsum was mixed with soil at rates varying from 0·25 to 256 gm. per lb., onion seeds were planted in the mixtures, and seeds or seedlings were pulled up and examined every other day. The compound had a marked effect on growth at all concentrations, and the experiment was therefore repeated with 0·005 16 gm. of the dust per lb. of soil. In this test, all seed germinated normally. When seedlings in untreated soil were one inch high, seedlings in soil containing 0·25 gm. dust or less were healthy, with no apparent difference between treatments, and those in soil containing 0·5 gm. were showing a normal number of shoots above the surface, though the shoots were shorter and thicker than the others. Seedlings in soil containing 1 gm. dust per lb. had very few shoots visible above the surface, and these were considerably thickened at the base, and those in soil containing 2 gm. or more had none, seedlings that were removed for examination showing the characteristic thickening and also marked browning of the tip of the rootlet. Later observations showed that these effects became progressively more pronounced, and, at the end of the experiment, it was thought that the plants in soil containing 0·25 gm. per lb. showed a very slight thickening of the shoot.

It is concluded that applications of benzene hexachloride to the soil should always be of the minimum quantity that will give satisfactory control of the insect concerned, and information on the rate of volatilisation of the chemical must be secured before it can be safely recommended for the control of such a pest as the onion maggot, against which applications must be made to the soil at the base of the plant.

Bibby (F. F.). *Neurocolpus nubilus*, **a Cotton Pest.**—*J. econ. Ent.* **39** no. 5 p. 815. Menasha, Wis., 1946.

Observations indicated that *Neurocolpus nubilus*, Say, caused serious damage to cotton in Mississippi during 1946 and was more responsible for a low yield than any other insect. In many fields showing typical Mirid damage in Tunica, Coahoma and Monroe Counties, *N. nubilus* was more abundant than any other Mirid ; in some, it was the only one found, but in others, *Adelphocoris rapidus*, Say, *Lygus oblineatus*, Say, and *Psallus seriatus*, Reut., were also present. *N. nubilus* caused injury similar to combined damage by *P. seriatus* and *A. rapidus* and also yellowing of the exposed petal portions of immature squares. It was collected from *Croton capitatus*, in Pemiscot County, Missouri, in October 1946, in association with *Psallus seriatus*.

Muma (M. H.). **Unusual Feeding Injury by Corn Earworms.**—*J. econ. Ent.* **39** no. 6 pp. 815–816, 1 fig. Menasha, Wis., 1946.

In the course of surveys for *Diatraea grandiosella*, Dyar, in south-central Nebraska on 15th and 16th October 1946, rather frequent breakage of maize stalks at or just above or below the ear was noticed. Large, blackened, frass-filled cavities were found just above the joints at which the lodging occurred, and larvae of *Heliothis armigera*, Hb., were found in about 20 per cent. of the stalks. These were apparently from a late generation, as nearly half of them were only half to two-thirds grown. Estimates of damage in 30 fields in nine counties showed that all had some breakage due to *H. armigera* ; three fields had about 5 per cent. of the stalks lodged, but most had 1 per cent. or less.

The cause of this unusual type of injury is not definitely known, but it is thought that the prolonging of the maize season well into October, which resulted from a dry spring and a rainy autumn, had led to the production of a late brood of larvae at a time when the ears were mature and freezing temperatures had killed maize leaves and other cultivated and wild food-plants, so that no other food was available but the late maize stalks, which were still somewhat green.

Graham (C.) & Cory (E. N.). **Control of Grasshoppers injuring Apple Orchards.**—*J. econ. Ent.* **39** no. 6 p. 816. Menasha, Wis., 1946.

Melanoplus femur-rubrum, Deg., and *M. differentialis*, Thos., appeared in destructive numbers in apple orchards in Washington County, Maryland, on 15th July 1946 and were causing complete defoliation of trees in many orchards by 10th August. The standard poison-bran bait applied in late afternoon and evening and sprays containing nicotine sulphate and lead arsenate, DDT at various strengths in the form of a wettable powder or an emulsified solution, and a pyrethrum product were ineffective, but a commercial spray (DX) containing DDT, rotenone and pyrethrum gave about 85 per cent. kill when applied to the trees and ground cover, and benzene hexachloride (12 per cent. γ isomer) gave about 100 per cent. kill within six hours when applied to both trees and ground cover at 1–4 lb. per 100 U.S. gals. spray and about 95 per cent. when used at 1·5 lb. per 100 U.S. gals. on the ground cover only. Several hundred acres of apple orchards in western Maryland were sprayed with this material, and in all cases good commercial control was obtained with one application at about 400 U.S. gals. per acre of ground cover. It was considered advisable to avoid spraying the fruit, owing to the undesirable odour of benzene hexachloride, but samples of apples from trees sprayed with as much as 4 lb. per 100 U.S. gals. spray on 13th August 1946 had no detectable odour at harvest time.

Blanchard (R. A.), Chamberlin (T. R.) & Satterthwait (A. F.). **Controlling the Fall Armyworm in Sweet Corn and Popcorn with DDT.**—*J. econ. Ent.* **39** no. 6 p. 817. Menasha, Wis., 1946.

In the East St. Louis area of Illinois, *Laphygma frugiperda*, S. & A., often causes severe damage to the ears of sweet maize maturing after the beginning of September, and in Mississippi, where the work on popcorn was done, it sometimes attacks the whorls of the growing maize from May until autumn and causes severe damage to the ears, though most attacks have been reported in June, July and August, when the larvae feed chiefly in the leaf whorls. In both States, *L. frugiperda* and *Heliothis armigera*, Hb., often attack the same ears.

In the course of experiments on the use of DDT against *H. armigera* in ears of sweet maize, carried out in Illinois in 1944, it was found that 2 per cent. DDT in white mineral oil (80–90 secs. Saybolt) was very effective against both species and that ears treated by atomisation were somewhat better protected than those treated by injection. Certain emulsions containing DDT also gave good control, especially when atomised, but were not entirely satisfactory in other respects. In 1945, ears treated with mineral oil (85–95 secs. Saybolt) containing 2 per cent. DDT at the rate of 0·5 ml. per ear by injection or 1 ml. per ear by atomisation had neither larvae of *L. frugiperda* nor damage due to them at harvest, and both treatments gave almost perfect control of *H. armigera*. The three emulsions tested were rather more effective against *Laphygma* than *Heliothis*. One, which was relatively stable and was composed of a water dispersible powder containing 90 per cent. DDT, a condensation product of ethylene oxide and an alkylated cresol (Igepal CA Extra High Concentrate), white mineral oil (85–95 secs. Saybolt) and water (2 : 1 : 10 : 87) gave complete control of *L. frugiperda* when 0·5 ml. was applied to each side of the ear and almost complete control when 0·5 ml. was applied from one side or 0·25 ml. from each side. In the three tests with it, 69·4–88·2 per cent. of the ears were undamaged by *H. armigera* and the numbers of *Heliothis* larvae per ear averaged only 0·14, 0·22 and 0·11. All the untreated ears were damaged by one or both species and there were averages of 0·64 larvae of *L. frugiperda* and 0·89 of *H. armigera* per ear at harvest.

In experiments in 1945 near State College, Mississippi, on young popcorn plants heavily infested by larvae of *L. frugiperda*, which were feeding in the whorls and tassels, dusts containing 1–9 per cent. DDT in pyrophyllite, applied in sufficient quantity to penetrate the whorls and tassels, gave no control. A bait of 2 oz. DDT, 0·35 U.S. pint dark cane cooking molasses, 3 lb. bran and 1·5 U.S. pints water, dropped into the whorls of the plants, gave excellent control, and an emulsion of 9·48 gm. DDT, 18·96 ml. xylene, 0·75 ml. Igepal CA Extra High Concentrate and water to make 1 U.S. pint, applied in sufficient quantity to moisten the tassels and whorls and provide some excess that ran down into the middle of the whorls, gave some control, but much less than the bait.

The treatments apparently resulted in little or no DDT residue on the sweet maize kernels, but chemical analysis indicated that considerable quantities remained on other parts of both plants up to 26 days after treatment, and until further information is available on the magnitude and hazard of these residues, DDT should not be applied to parts of the plants that may be used for human or animal food.

Fenton (F. A.) & Afanasiev (M.). **Seasonal Cycle and Control of the Pine Tip Moth.**—*J. econ. Ent.* **39** no. 6 p. 818. Menasha, Wis., 1946.

The Nantucket [typical] variety of *Rhyacionia frustrana*, Comst., has for several years caused serious injury to ornamental and experimental plantings of pines near Stillwater, Oklahoma, and investigations on its bionomics and control were therefore carried out in 1946. Winter was passed in the pupal stage in the pine tips, and the periods of emergence of moths of the overwintered, first and second generations were 19th March–9th April, 1st–10th June and 10th–24th July, respectively. Some larvae of the third generation gave rise to adults on 5th–17th September, while some did not pupate until October and were thought likely to overwinter, and about half the larvae of the fourth generation had pupated by 24th October.

Plots of *Pinus echinata*, mostly trees less than 5 ft. tall, were sprayed at a pressure of 400–600 lb. per sq. in., until the tips were thoroughly drenched. Trees sprayed on 30th March with 0·48 and 1 per cent. DDT as a water

dispersible powder and with 1·6 pints nicotine sulphate and 7·5 pints summer oil per 100 gals. water and unsprayed trees had 0, 1, 16 and 72 per cent. infested tips, respectively, on 9th May. On 7th June, the first DDT treatment was repeated against the second generation, but the second was not, in order to determine the possible effect of the residue from the March application, and on 5th July, the percentages of tips infested on these two plots and the untreated plot were 1, 39 and 62. The same two plots received a spray of 0·118 per cent. DDT as the dispersible powder on 19th July, but no spray against the fourth generation, and the percentages of tips infested on these and the untreated plot were 3, 15·2 and 74 on 29th August and 52, 70 and 90 on 24th October.

The DDT sprays were thus more effective than nicotine sulphate and oil, but had no effect after two months, and it is concluded that they will give effective control, provided that they are applied before the young larvae enter the terminals and are directed into the terminals with sufficient force to penetrate the cluster of needles. If only small blocks are treated reinfestation is likely, so that sprays should be applied against each generation, but if all infested trees in the neighbourhood can be sprayed, one or two properly timed applications would probably suffice.

Shaw (F. R.), Bourne (A. I.) & Hathaway (W. B.). **Laboratory Tests in controlling Pillbugs.**—*J. econ. Ent.* **39** no. 6 pp. 818–819. Menasha, Wis., 1946.

In laboratory tests on the use of DDT for the control of *Armadillidium vulgare*, Latr., and *A. nasatum*, Budde-Lund, which have frequently caused severe damage in greenhouses in Massachusetts, batches of five woodlice were dusted with DDT powders and kept in small boxes and others were kept in similar boxes containing 1 gm. DDT powder, in order to determine whether constant contact would produce more rapid mortality. Some of the boxes in each series had tin covers and others were covered only with muslin to ascertain whether the fluctuations in humidity in the greenhouse would reduce the toxic action of DDT or, because of lack of sufficient moisture, hasten death. A small piece of moistened manure was provided as food in each box. Dusts containing 3, 5, 10 and 40 per cent. DDT were used. The results were expressed graphically, and from the graphs it was apparent that all treatments caused death, kill of all woodlice in a given container requiring 1–5 days. On the whole, the examples in constant contact with DDT were killed sooner than those not continually exposed, although the difference was not sufficient to interfere with control under greenhouse conditions, and variations in humidity did not appreciably influence the effectiveness of the DDT or the length of life of the woodlice. Those in constant contact with DDT were usually killed more rapidly as the percentage of DDT was increased, but those not continually exposed were killed less rapidly as the percentage increased, possibly because the inert ingredient caused a greater amount of DDT to adhere.

It is thought that 3 per cent. DDT would be the most economical strength to use, but less concentrated dusts might possibly be effective.

Harrison (P. K.). **Insects attacking Cole Crops in Louisiana.**—*J. econ. Ent.* **39** no. 6 pp. 820–821, 1 ref. Menasha, Wis., 1946.

The 17 species of insects that were found in different cruciferous crops (green and red cabbage, cauliflower, collards, broccoli, Brussels sprouts, kale and kohlrabi) in the course of an experiment carried out in Louisiana in 1939–41 are recorded in a table, which shows the crop or crops on which each occurred. The experiment was designed to determine the relative abundance of *Trichoplusia ni*, Hb. (*Plusia brassicae*, Ril.), *Pieris rapae*, L., and *Plutella maculipennis*,

Curt., on the different crops, which were set out at random so that they were equally liable to infestation and all of which were infested by each of these three species. A list is also given of 14 additional insects that were found on green cabbage during the spring and autumn growing seasons of 1932-43.

DeBach (P.). **Detrimental Effect of Rotenone on** *Rodolia cardinalis*.—*J. econ. Ent.* **39** no. 6 p. 821, 1 ref. Menasha, Wis., 1946.

Since *Icerya purchasi*, Mask., which is generally kept under control by *Rodolia cardinalis*, Muls., in California, was fairly numerous in August 1946 in a *Citrus* grove that had received an oil spray containing rotenone in April, laboratory tests were carried out to determine the effect of rotenone on the Coccinellid. Leaves from a tree that had been sprayed with 0·95 lb. cubé (5 per cent. rotenone), 0·3 lb. blood spreader and 1·5 U.S. gals. kerosene in 100 U.S. gals. water on 7th August were picked after a weathering period of 14 days with daily temperatures ranging up to 90°F. or more and put in petri dishes with adults of *Rodolia* that emerged from pupae collected in the field. Food and water were supplied. The percentages of the beetles dead in 1, 2, 3 and 4 days on treated and (in brackets) untreated leaves were 12 (3), 48 (11), 76 (23) and 100 (26), indicating that it may be dangerous to apply rotenone to *Citrus* trees bearing incipient infestations of *I. purchasi*, because of its adverse effect on the predator, especially if two or more applications are made during the season or if it is used before or after DDT [*cf. R.A.E.*, A **36** 145].

Fisher (E. H.) & Allen (T. C.). **Spittle Insect Damage to Alfalfa and Red Clover.**—*J. econ. Ent.* **39** no. 6 pp. 821–822, 1 fig. Menasha, Wis., 1946.

Abnormally large populations of Cercopids occurred on lucerne and red clover in Wisconsin in 1944 and 1945, and carrots, peas, strawberries and other crops were also infested by both nymphs and adults. Insect damage to the lucerne and clover was evident even in fields with heavy plant stands, and careful observations showed dwarfed, rosetted, blossom-blasted and necrotic conditions of many infested plants. Adults collected on them were identified as belonging to four varieties of *Philaenus leucophthalmus*, L., and when they were caged on healthy second-growth lucerne and clover plants, damage like that observed on first-growth plants was obtained after one month of feeding. It included very shortened internodes and appeared to be distinct from the yellows induced by the potato leafhopper [*Empoasca fabae*, Harr.], since the foliage remained quite green and rosetting was common.

Yust (H. R.), Nelson (H. D.) & Fulton (R. A.). **Effect of Oil Sprays on Resistance of California Red Scale to HCN Fumigation.**—*J. econ. Ent.* **39** no. 6 pp. 822–823, 4 refs. Menasha, Wis., 1946.

Some growers in California consider that the application of oil sprays against *Aonidiella aurantii*, Mask., on *Citrus* increases the susceptibility of the progeny to fumigation with hydrocyanic acid gas. To test the validity of this opinion, scales of a resistant strain that had received 14 laboratory fumigations [*cf. R.A.E.*, A **32** 271] were treated with oil sprays and offspring of the survivors fumigated. The sprays were applied to three successive generations when the females were mature but before reproduction began; 1 per cent. light medium oil was applied in the first two sprays and 0·75 per cent. in the third, and the mortality from each was over 50 per cent. Offspring from the survivors of the first and third sprayed generations were reared on lemon fruits at fluctuating temperatures and at a constant temperature of 77°F., respectively, with corresponding control generations of the same strain, and fumigated with a constant concentration of hydrocyanic acid for 40 minutes. Scales in the

second moult were fumigated with 1·39 mg. per litre after the first oil spray and 1·57 mg. per litre after the third, and mature females with 0·4 mg. per litre in both cases. The mortality percentages for the offspring of the sprayed and unsprayed scales were 27·8 and 28·6 for the second moult and 44·2 and 48·2 for the mature females after the first spray, and 46·4 and 48·1 for the second moult and 30·3 and 39·4 for the mature females after the third. A very high mortality resulted from the second spray application, and sufficient offspring were not available for a test after this treatment.

It is concluded that oil sprays applied to *A. aurantii* did not decrease the resistance of its progeny to fumigation, and that the beneficial results attributed to substituting spray treatments in a fumigation programme are probably due to the fact that oil sprays give the better kill on the outer part of the tree, and on the fruit, and fumigation on the inner part, particularly on the wood.

Neal (P. A.) & others. **Results of Examinations of three Men having relatively long continued occupational Exposure to DDT.**—[2+] 44 pp., multigraph. Bethesda, Md., U.S. Publ. Hlth. Serv., Nat. Inst. Hlth., Industr. Hyg. Res. Lab., 1944.

Detailed results are given of a thorough clinical and laboratory study of three relatively young healthy men who had been subject to occupational exposure to DDT insecticides, two to a very great extent from the beginning of October 1943 to mid-January 1944, when they were spraying and dusting continuously and were exposed to the compound by inhalation and cutaneous contact, and intermittently from then until they were examined in June. The third underwent less intense but constant exposure to aerosols and sprays for nine months before examination. It is concluded from an evaluation of the results of these examinations that they fail to provide any definite evidence of toxic effects from the exposure to DDT, but that certain of the findings in the man who had continuous exposure up to the time of examination, though not of sufficient importance to be considered as indicative of pathological changes at the time of examination, indicated the advisability of repeating this examination in a few months if exposure continued.

Neal (P. A.) & von Oettingen (W. F.). **The Toxicity and potential Dangers of DDT to Humans and warm-blooded Animals.**—*Med. Ann. District Columbia* **15** no. 1 pp. 15–19, 9 refs. [Washington, D.C.] 1946.

The authors give the results of investigations carried out in the United States in 1943–45 to determine the toxicity and potential danger of DDT to man and warm-blooded animals when used as a dust, spray, mist or aerosol. When applied in solutions or emulsified solutions or as a powder, DDT adheres to any surface with which it comes in contact and is not very liable to form a dust on agitation of the air. The small particles of DDT in atomised sprays and aerosols can be absorbed through the lower sections of the respiratory tract, but because of the relatively small amount of DDT present in insecticidal mixtures, the actual concentration of DDT in the air is small. There is, however, considerable contamination from the solvents used, and these are liable to irritate the skin and mucous membranes and may cause systemic effects such as nausea, vomiting, fatigue and headache. Only the least harmful solvents have been recommended; the chlorinated hycrocarbons, such as carbon tetrachloride and tetrachlorethane, should not be used as solvents for DDT.

The effect of DDT on at least twelve species of warm-blooded animals has been studied and it was found that the lethal dose per unit body weight by any method of administration varied considerably between species and that young

animals were usually more susceptible than adults. Investigations on the effect of metabolism on DDT showed that it was partly oxidised to bis(parachlorphenyl) acetic acid (DDA) in rabbits, and this metabolite has been recovered from the urine of man and animals. The symptoms of DDT poisoning in animals are described, and it is pointed out that, even in fatal acute poisoning and often in chronic poisoning, the pathological changes found are not sufficiently marked to account for death; it appears, therefore, that the mechanism of action of DDT is essentially of functional character. It is considered that DDT poisoning in man would result in nervous symptoms similar to those in laboratory animals.

Details are given of cases in which no toxic effects were observed in man after exposure to large amounts of DDT in the form of aerosols in a closed chamber, after the ingestion of DDT in olive oil on an empty stomach, the larger of the two doses tested being equivalent to 11 mg. DDT per kg. body weight, or after prolonged occupational exposure to DDT [see preceding abstract]. A study of all the cases of suspected DDT poisoning in the United States reported to the authors revealed none in which the signs and symptoms were considered to be due to DDT.

It is emphasised that although DDT is definitely less toxic to man than Paris green or sodium fluoride, it has toxic properties and should be used with due precautions. The treatment of DDT poisoning, for which there is no specific antidote, is briefly described.

Minutes of Conference on Toxicity of DDT to Man and other Mammals and the Hazards involved in the agricultural Use of DDT.—29 pp., multigraph. Washington, D.C., Nat. Res. Coun. Biol. Subcomm., 1946.

This symposium contains the text of papers read and of discussions on them at a meeting called to review the evidence of acute and chronic toxicity of DDT to man and animals, to evaluate the hazards involved in the agricultural use of DDT and to consider what further steps need be taken to clarify the confusion that now exists in regard to these problems.

The Effects of Exposure to DDT in Man, by P. A. Neal (pp. 11–14), consists of parts of the paper noticed above [see preceding abstract], and **The agricultural Applications of DDT, with special Reference to the Importance of Residues,** by G. C. Decker (pp. 15–24), has been abstracted from another source [*R.A.E.*, A **36** 81].

In **The chronic Toxicity of DDT in Mammals,** by J. H. Draize (pp. 7–9), the author states that there are wide individual variations in susceptibility to DDT poisoning in all the animal species studied, and that the compound appears to be stored selectively by fat, but that, on the cessation of feeding on foods contaminated with DDT, the quantity in the fat declines to negligible levels in 45–60 days. He concludes that there is little danger from contact of DDT powders with the skin or from the inhalation of aerosols, mists, sprays or dusts, whereas fatal poisoning may occur if DDT is absorbed through the skin from solutions. The wide individual variation in susceptibility to DDT poisoning, regardless of the method of administration, makes it difficult to establish safe tolerance limits to cover all individuals, and the tentative tolerance of seven parts per million, set for apples and pears by the United States Food and Drug Administration [**35** 110], may have to be revised if man is to be exposed to DDT from other sources, such as meat and dairy products.

In **The Pharmacology of acute DDT-poisoning in Mammals**, by F. S. Philips (pp. 2–6) the symptoms and treatment of acute DDT poisoning are described and it is concluded that this can be expected in man usually only as a result of gross carelessness.

KEENAN (W. N.). **The European (Dutch) Elm Disease Situation in Canada.**—*76th Rep. ent. Soc. Ont. 1945* pp. 10–13, 1 map. Toronto, 1946.

Despite precautionary measures to prevent the introduction of Dutch elm disease [*Ceratostomella ulmi*] into Canada [*cf. R.A.E.*, A **23** 233; **25** 370] an outbreak was discovered in the second half of 1944 in Quebec, where elms in a belt 45 miles long round Lake St. Peter were found to be infected. It was considered unlikely that the fungus had originated from the United States, since the nearest point of infection there was 250 miles away, but it might have been introduced in crates partly made of elm wood, which were used to ship goods from England. *Hylastes* (*Hylurgopinus*) *rufipes*, Eichh., is the only vector that has so far been found in the infected area.

Following a conference on 12th–13th March 1945, scouting was begun to determine the extent of the infected area in Quebec and whether the disease was present in Ontario and the Maritime Provinces, and a regulation passed on 24th April controlled the movement of elm and elm products, which is only permitted if they are free from bark, from and within 11 counties in the Lake St. Peter area. During the ensuing summer, however, the disease was found by culturing to be present over an area 150 miles long and 100 miles wide, including 24 counties and extending from west of Montreal almost to Quebec city; this area and the distribution of infection within it are shown on a map. In all, 1,349 elms were found to be infected; most of these were cut down in 1945 and the rest were to be destroyed before the spring of 1946. No indication was obtained that the disease was present in Ontario or the Maritime Province.

THOMPSON (R. W.) & GOBLE (H. W.). **European Corn Borer Infestation Counts in Ontario 1945.**—*76th Rep. ent. Soc. Ont. 1945* pp. 14–15. Toronto, 1946.

A table is given showing the percentages of maize stalks infested by the European corn borer [*Pyrausta nubilalis*, Hb.] in each of the years 1940–45 in the 20 counties of Ontario in which clean-up regulations are in force. Infestation was 4·77 per cent. greater than in 1944 [*R.A.E.*, A **35** 9] in 16 of them, but there was little or no commercial injury to either hybrid or open-pollinated strains of field maize or to most of the maize for canning; damage was greatest on very early sweet maize. The disposal of maize débris was satisfactory everywhere except in areas that were water-logged as a result of wet weather in spring, in which it was sometimes delayed until late June or early July; in the western part of the area, much of it is ploughed in and disked rather than burnt. In recent years, there has been a tendency to delay the sowing of canning maize so that the plants have not reached an attractive stage when the moths are ovipositing. The sowing dates of both husking and canning maize were retarded by the wet weather in 1945, however, and in consequence the development of the maize was more uniform than usual. The more even distribution of the larvae is attributed in part to this. Infestation was concentrated in well-drained fields on light soil on which earlier sowing was possible, but there was relatively little damage to the ears, since in most cases there were not enough larvae per stalk to cause the stems to break in the hybrid strains in which the higher populations occurred. Mechanical harvesters were used to a greater extent than in previous years and appear to assist the disposal of maize refuse, since the stems are broken in the middle and are then more readily covered by means of suitable ploughs.

HAMMOND (G. H.). **White Grub Infestations in Ontario during 1945.**—*76th Rep. ent. Soc. Ont. 1945* pp. 15–18, 3 refs. Toronto, 1946.

Severe outbreaks of second-year larvae of brood C of *Lachnosterna* (*Phyllophaga*) spp. occurred in Ontario in counties north of Lake Erie in 1944 and of

brood A over the rest of the chief agricultural areas in 1945 [*cf. R.A.E.*, A **33** 140, etc.]. In the latter year, the summer was exceptionally wet and cold and losses did not reach a maximum until August–September. Crops were damaged over wide areas of light or moderate infestation, and localised areas of severe infestation occurred in seven counties, but losses were greatest in two other regions to the west and north of Lake Ontario. Of these, the former extended over some 600 square miles comprising contiguous parts of five counties ; the species concerned were *L.* (*P.*) *inversa*, Horn, *L.* (*P.*) *rugosa*, Melsh., *L.* (*P.*) *fusca*, Froel., *L.* (*P.*) *futilis*, Lec., and *L.* (*P.*) *anxia*, Lec., all of which were common throughout the area, with local variations in numbers. Pasture, especially on rough, boulder-strewn, non-arable land, and grain crops, including fodder and grain maize, sown without adequate protective measures on land that had been under grass in 1944 were seriously damaged ; losses of root crops, garden vegetables, ornamental plants and lawns were considerable and losses of potatoes were believed to be extensive. The other heavily infested area covered at least 2,500 square miles in six counties, but *L. anxia*, and *L. fusca* were the only species involved, and *L. fusca* was confined to two counties. Damage to arable and non-arable pasture and meadow was often severe, many hay crops of timothy grass [*Phleum pratense*] were a total loss, maize was seriously injured, especially when surrounded by grass land, and many stands of oats, which is the only grain crop extensively produced, and crops of potatoes were completely destroyed. Root crops were less seriously damaged, and injury to garden vegetables and ornamental plants varied in intensity. It is thought that this infestation has been in existence for many years and is probably one of the primary reasons for the large number of abandoned farms in the area.

Third-year larvae of brood C caused only minor damage during their short feeding period in 1945, principally affecting new strawberry plantations made without adequate protective measures on land previously under grass.

MORRISON (F. O.). **Comparing the Toxicity of synthetic organic Compounds.**—*76th Rep. ent. Soc. Ont. 1945* pp. 18–20, 12 refs. Toronto, 1946.

Since DDT and related compounds act largely, and especially as regards flies, by virtue of a lethal residue on a surface and any comparative method of testing their efficiency must be capable of reproducing accurately and day after day extremely dilute dosages, known laboratory testing methods have proved inadequate. A new one that has given good results is here described. Filter papers $1{\cdot}25 \times 2$ ins. are immersed in alcohol or acetone solutions of the materials under test, dried on a frame covered with clean unbleached cotton and stored in a cupboard until required. Control papers are impregnated with 95 per cent. ethyl alcohol alone. The papers are used to line small shell vials, ten for each dosage, and each vial is stocked with 15 adults of *Drosophila melanogaster*, Mg., 4–5 days old, and plugged with absorbent cotton wrung out in a 5 per cent. molasses solution. All concentrations of all materials are tested on one day, 5–12 dosages of each material are used, and the whole experiment is repeated on 8–10 different days. Mortality counts are made after 24 hours, when total mortality has reached a maximum and mortality in the controls has not begun. The results may be affected by loss of activity from the sprayed surface and fumigant effects, and possibly by the nature of the crystals deposited by solutions of different strengths.

THOMPSON (R. W.). **DDT for Potato Leafhopper Control—Progress Report 1945.**—*76th Rep. ent. Soc. Ont. 1945* pp. 22–26. Toronto, 1946.

Since injury to potatoes by *Empoasca fabae*, Harr., which causes hopperburn, has been substantial in recent years in Ontario, experiments on the control of

this Jassid and of fungous disease were begun in 1945. Thirty dust and spray treatments, including Bordeaux mixture, fixed copper compounds and some recently developed organic fungicides, with or without the addition of DDT or a thiocyanate (Lethane B-72), and the two insecticides alone were applied at rates considerably higher than those generally employed, to plants in experimental plots ; eight or nine applications were made, the last on 3rd or 11th September. The formulae for the mixtures and their effects on injury by *Empoasca* and on yield are shown in tables. The DDT sprays contained 12½ oz. AK40 [40 per cent. DDT] per 100 gals., and the DDT dust 1 per cent. DDT, and all were more effective than similar formulae from which DDT was omitted ; the sprays were superior to the dust, which contained lime. The best results were given by a DDT spray containing also 2 quarts Dithane [disodium ethylene bisdithiocarbamate], 1¼ lb. zinc. sulphate and 10 oz. lime per 100 gals., which reduced the number of areas damaged by *Empoasca* on the leaves of ten shoots collected at random on 6th–7th August from 797 to 101 and increased the yield from 236 to 618 bushels per acre ; the corresponding figures for the spray of DDT alone were 220 and 398. On 31st August, the foliage of plants sprayed with DDT alone was free from hopperburn, but late blight [*Phytophthora infestans*] had begun to appear. The foliage in the plot sprayed with Dithane and DDT appeared the most vigorous at this date ; that sprayed with Bordeaux mixture (10 : 10 : 100) and DDT was only slightly inferior, but the yield from this plot was slightly lower than that from the one sprayed with DDT and 2½ lb. Fermate [ferric dimethyl-dithiocarbamate] per 100 gals. water, which gave 524 bushels per acre. Significantly increased yields were given by sprays of Dithane, Fermate and a proprietary fixed copper fungicide when used with zinc sulphate and lime and also by sprays of Lethane alone or in combination with fungicides.

Fox (C. J.) & Perron (J. P.). **Report on a Potato Leafhopper Control Experiment at Ottawa with DDT and Copper Sprays (1945).**—*76th Rep. ent. Soc. Ont. 1945* pp. 27–31, 2 refs. Toronto, 1946.

Tests of DDT alone or with fungicides in sprays against *Empoasca fabae*, Harr., *Epitrix cucumeris*, Harr., and *Leptinotarsa decemlineata*, Say, on potato were begun in the Ottawa district of Ontario in 1945, when there was a serious outbreak of *Empoasca*, which is not as a rule of importance there, and the results relating to this Jassid are given in detail. The fungicides were Bordeaux mixture (4 : 4 : 40) or yellow cuprous oxide (a proprietary fungicide stated to contain at least 47 per cent. copper) at 1½ lb. per 40 gals. The DDT was used at 0·4 lb. per 40 gals. as an emulsion of a solution of 8 oz. DDT and 2 oz. Triton X-100 in enough Velsicol AR60 to make 1 quart liquid, or at 0·08 lb. per 40 gals. as a 20 per cent. water-dispersible powder. Sprays containing calcium arsenate (1½ lb. in 40 gals.) alone or with the two fungicides, and one of 2 lb. lead arsenate and 4 lb. sulphur in 40 gals. water were also applied.

Eight applications, at a rate of about 65 gals. per acre, were made between 3rd July and 6th September, and seven weekly counts of the nymphs on central leaflets were made from 31st July onwards. The numbers found on the total 960 leaflets examined from the plots receiving each treatment were 0 for all sprays containing 0·4 lb. DDT per 40 gals., 37–46 for the sprays containing 0·08 lb. DDT, 237 for the spray of Bordeaux mixture with calcium arsenate and over 300 for the other sprays. Hopperburn did not occur on plants sprayed with the DDT suspensions and emulsions until ten days and over three weeks, respectively, after it had appeared on the other plants ; 90, 50 and 18 per cent. of the plants sprayed with the emulsions, the suspensions and the arsenicals, respectively, were uninjured or only lightly damaged, and the yield from plots (eight 30-ft. rows) that received these three treatments averaged 134, 109 and 95 lb., respectively. The emulsions gave excellent control of both *Epitrix* and *Leptinotarsa* and the suspensions were superior to the arsenicals against the

latter, but not the former. Some indications were obtained that the effectiveness of DDT is reduced in the presence of copper fungicides and hydrated lime [*cf. R.A.E.*, A **34** 239], as in Bordeaux mixture, but it appeared to be quite compatible with the cuprous oxide.

THOMPSON (R. W.) & GOBLE (H. W.). **An interesting Infestation of Garden Beans by *Hypera meles*, Fab.**—*76th Rep. ent. Soc. Ont. 1945* pp. 31–32. Toronto, 1946.

Bean leaves submitted for examination on 1st August 1945 from a farm in Wentworth County, Ontario, were found to bear an average of 50–75 adults of *Hypera meles*, F., which is one of the commonest insects on alsike, red and white Dutch clovers [*Trifolium hybridum*, *T. pratense* and *T. repens*] in Ontario. Investigations on the farm showed that beans were the only plants infested in the vegetable garden and bore from 100 to over 200 weevils each. The leaves were broken over and skeletonised. In the case of pole beans, the weevils congregated on the sticks and strings. The garden adjoined a barn containing hay, which included some red clover, and the beetles were migrating from this to the beans. Red clover flower heads in the hay contained large numbers of cocoons of *H. meles*; many of the adults had already emerged, and only a few were seen in the barn. Adults of *H.* (*Phytonomus*) *nigrirostris*, F., were also present on the bean foliage with *H. meles*, in the proportion of 1 : 12. A similar infestation of beans by *H. meles*, of about the same intensity, was recorded in another county on 3rd August.

SMITH (R. W.) & STEWART (W. W. A.). **A useful Cage for sampling Field Populations of Grasshoppers.**—*76th Rep. ent. Soc. Ont. 1945* pp. 32–35, 5 figs., 1 ref. Toronto, 1946.

The apparatus described has been satisfactorily used for two years in connection with a study of parasitism in grasshoppers in western Canada [*cf. R.A.E.*, A **32** 297]. It consists of a shallow tray and a shallow cage. The tray is made of sheet metal and has three low wooden sides with triangular fibre-board wings rising from the two opposite ones. The cage has four wooden sides and a 20-mesh wire-screen top and encloses an area of 1 sq. yd. It is thrown forward so that it falls on the ground 10–15 ft. away, screen side uppermost. The tray is placed with its open end under the cage, which is then worked carefully forward on to it. Most of the grasshoppers move forward with the cage, and it is important that the tray should not be moved forward under the cage, since by this method the sample area becomes covered. The few grasshoppers that escape are caught and included with the rest of the sample. When the cage covers the tray, the end is held in position by means of two metal clamps. The apparatus is then raised so that it rests vertically on its end, and the cage and tray moved apart to form a V, when the wings prevent the grasshoppers from escaping from the sides. The hoppers are removed by means of an aspirator collector and the adults by hand.

Sampling by means of a net is affected by weather, time of day, the height at which the sweep is taken and the sluggishness of parasitised grasshoppers, and it was thought that the cage method would eliminate these factors. In 1944, comparative tests showed that it gave a sample closely approximating to one from 15 yard-long sweeps of a 15-inch net, but this similarity was not repeated in the early part of 1945, when the populations were not evenly distributed. It is suggested that the cage method would be of value where precise samples are required and the vegetative cover not dense. It gave satisfactory results on pasture with some coarse weeds and in light stands of lucerne and ragweed. Two operators are necessary.

Boyce (H. R.). **Larvae of *Spilonota ocellana* (D. & S.) used to provision Nests of a Eumenid Wasp.**—*76th Rep. ent. Soc. Ont. 1945* pp. 35–37, 4 refs. Toronto, 1946.

Larvae of *Spilonota ocellana*, Schiff., were found in nests of *Odynerus tigris*, Sauss., in insect galls on golden rod (*Solidago*) in an apple orchard in the Niagara district of Ontario on 6th June 1945. Of the 13 nests discovered, only two were completed, and one of these was not opened. The four cells in the other and all the completed cells in the uncompleted nests examined each contained 1–11 larvae of *Spilonota*, usually five, and one egg of *Odynerus*. The only other larvae in the cells were three of *Coleophora cerasivorella*, Pack. (*fletcherella*, Fern.) found in two cells in one nest. Three of 19 eggs from which the life-cycle of the wasp was studied failed to hatch when transferred to vials with the partly paralysed host larvae, and the rest hatched 1–3 days after collection. Development from egg to adult lasted 34–40 days, and adults from nests collected on 6th and 7th June had all emerged by 16th July. It is possible that there may be a second generation in the year, and since the larvae of *S. ocellana* present when it would occur are very small, those of some other species may be used as food. Of 150 leaf clusters infested by *S. ocellana* in the orchard on 9th June, 26·6 per cent. were empty, but some of this reduction in numbers may have been due to insectivorous birds and migration of the larvae. Nevertheless, *O. tigris* is probably of some value against *S. ocellana*.

Twinn (C. R.). **A Summary of the more important Insect Conditions in Canada in 1945.**—*75th Rep. ent. Soc. Ont. 1945* pp. 49–55. Toronto, 1946.

In addition to many pests of common occurrence in Canada, the insects recorded include *Phyllotreta aerea*, Allard, a European Halticid that was collected at Chatham, Ontario, in 1944 and caused extensive damage in 1945 in south-western Ontario, where it was reported to be the most abundant and destructive flea-beetle attacking radish and cabbage, and the tomato pinworm, *Keiferia lycopersicella*, Busck, which was recorded in Canada for the first time and was found in greenhouses at three places in Ontario. *Epitrix tuberis*, Gentner [*R.A.E.*, A **35** 13] increased in abundance on the lower mainland of British Columbia and was so injurious to potato in one area that the commerical cultivation of the crop was discontinued. Local infestations of beans by *Epilachna varivestis*, Muls., occurred in Quebec and Ontario ; it has not been reported in the Saint John River Valley, New Brunswick, since it was first found in that Province in 1942 [**32** 284]. *Pyrausta nubilalis*, Hb., occurred on maize in four counties in that Valley for the first time for 14 years [*cf.* **32** 284] ; the infestations, which were light and scattered, were probably caused by moths that entered the Province with the strong south-west winds that prevailed in July and August. Damage by *Cydia* (*Grapholitha*) *molesta*, Busck, to peach in the Niagara district of Ontario was probably the worst yet recorded ; considerably heavier infestations had occurred prior to 1930, but were local, whereas injury was severe throughout most of the peach-growing area in 1945. Losses were heaviest where the crop was small, especially in the west, but were also great on late varieties in the east. The outbreak is attributed in part to favourable weather, but chiefly to a low level of parasitism. Infestation of fruit by *C. molesta* in the south-west was less severe than elsewhere, though heavier than for some years.

Maheux (G.) & Gauthier (G.). **Recherches sur le hanneton commun *Phyllophaga* spp.**—*Mém. Minist. Agric. Québec* (1) no. 1, 72 pp., 50 figs., 85 refs. [Quebec] 1944.

The results are given of investigations carried out since 1935 on species of *Lachnosterna* (*Phyllophaga*), particularly *L. anxia*, Lec., which cause serious

damage in the most important agricultural regions of Quebec. They include details of the geographical distribution, bionomics, ecology and economic importance of the beetles [*cf. R.A.E.*, A **29** 89 ; **33** 140] and of experiments on control [**28** 426 ; **33** 141] supplemented extensively by comparative data from the literature.

Nel (R. G.) & Mathew (G. E. A.). **The toxic Life of Pyrethrum-in-oil Films.**—*Sci. Bull. Dep. Agric. For. S. Afr.* no. 239, 13 pp., 2 figs., 6 graphs, 6 refs. Pretoria, 1944.

The results are given of laboratory experiments carried out in South Africa to determine how long a film such as results from the application of pyrethrum extract in oil for the control of storage insects in warehouses would retain its toxicity [*cf. R.A.E.*, A **27** 154]. The tests were made during midsummer, when the average midday temperature was 75–85°F., and special attention was paid to the effect of light and air on the films. Sheets of thin sulphite fruit-wrapping paper were pressed against steel ferrotyping sheets painted with liquids consisting of a standard pyrethrum extract diluted with a highly refined white mineral oil or kerosene to contain 0·5 per cent. total pyrethrins and 0·27 per cent. pyrethrin I ; the amount of liquid on each paper was adjusted to an average of 2 mg. per sq. in. The specifications of the two carriers are given. After the treated sheets had been exposed for varying periods to sunlight, subdued light or darkness, some of them were formed into cylinders in which full-grown migrating larvae of *Ephestia elutella*, Hb., were kept for an hour, while others were analysed for content of pyrethrin I. Percentages of control were calculated according to Abbott's formula [**13** 331]. The results obtained showed that the toxic principles, particularly pyrethrin I, decompose rapidly on exposure to direct sunlight but remain active much longer in subdued light or darkness. Films from pyrethrum in kerosene gave only 54 per cent. control before exposure and only 30 per cent. after exposure for six hours, regardless of light intensity. Films from pyrethrum in white oil gave 99 per cent. initial control and approximately 80 per cent. after exposure in the dark for 48 hours, less than 50 per cent. after 36 hours in subdued light and less than 20 per cent. after six hours in sunlight. Pyrethrin assays showed that the films from pyrethrum in kerosene did not lose their content of pyrethrin I so quickly as those from pyrethrum in white oil, and their lower effectiveness is attributed to the rapid evaporation of the solvent, which led to poor contact with the insecticide. In preliminary tests on a non-absorbent surface, however, pyrethrum in white oil lost its pyrethrin I content more slowly than pyrethrum in kerosene.

It is concluded that the period of effectiveness of a film of pyrethrum in oil varies largely with the intensity of light to which the film is exposed, the volatility of the carrier used and the absorptiveness of the surface on which it is deposited, and that it may be advisable to have a minimum of light entering warehouses after spraying.

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The Institute will be greatly indebted to readers who may be able to supply any of the following, which should be sent to the Director, Commonwealth Institute of Entomology, 41, Queen's Gate, London, S.W.7.

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